SCIENTIFIC COMMUNICATIONS AND NATIONAL SECURITY

HEARING

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

AND THE

SUBCOMMITTEE ON
INVESTIGATIONS AND OVERSIGHT

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY HOUSE OF REPRESENTATIVES

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SCIENTIFIC COMMUNICATIONS AND NATIONAL SECURITY

THURSDAY, MAY 24, 1984

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AND THE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT,

Washington, DC.

The subcommittees met in joint session, pursuant to call, at 9:40 a.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the Subcommittee on Science, Research and Technology) presiding.

[The opening remarks of Mr. Walgren follows:]

OPENING REMARKS BY HON. DOUG WALGREN

On behalf of Congressman Gore and myself, I want to welcome everyone to this joint hearing on Scientific Communication and National Security. The Subcommittee on Science, Research and Technology joins with the Subcommittee on Investigations and Oversight in sponsoring this hearing on a topic of present day importance and enormous consequences for the future. This hearing is a follow-up to our Subcommittees' March, 1982 hearing, as we continue to examine the possible effects on scientific research and scientific exchange brought about by new or proposed restrictions imposed for the purpose of national security. We are keenly interested in how such restrictions will effect the vigor and vitality of the open environment necessary for progress in science and technology.

All of us share the goal of national security. With the rapid progress of science comes an increase in sophistication of military weapons and the means to design and manufacture them. As a result, new technology can be used for both civilian and military purposes. Such a trend has ramifications for our national security in as much as our adversaries could apply data developed by American scientists to their own weaponry. At the same time, science needs an open environment in order to flourish. Productive academic research depends on free exchange in the academic and scientific communities. Any restrictions of such open communications must be undertaken with the most deliberate consideration. Balancing these two important factors, free scientific exchange and national security, is the goal we bring with us to today's hearing.

We are pleased to welcome a very distinguished array of witnesses from academia, industry, and government. All of these witnesses have a unique perspective on the effects on scientific communications brought about by national security considerations. The academic witnesses come to us from the nation's most prestigious universities. We are interested in their view on how present and proposed restrictions impact on university research and scientists. The witnesses from industry will provide us with an overall discussion of this issue and, in particular, how government policy in this area effects commercial trade and technology transfer. Finally, the panel of witnesses representing the departments will discuss how they intend to deal with scientific communication and national security, as well as the effects on the research programs conducted under their supervision.

At this point, I want to request unanimous consent to include in the record two excellent articles describing the background and intricacies of this issue. I do so for

the purpose of providing a solid compendium of literature in connection with our discussion today.

I want to welcome Rep. Dan Glickman, Chairman of the Subcommittee on Transportation, Aviation and Materials. Mr. Glickman has a strong interest in this issue in general, as well as an interest in the impacts on advanced materials research.

Our first witness is Rep. Ed Zschau of California. Mr. Zschau brings a great deal of experience as a former chief executive of a successful high-tech firm, as well as a knowledge of export controls.

Mr. WALGREN. Let me call us to order.

On behalf of Congressman Gore and myself, I want to welcome everyone to this joint hearing on scientific communications and national security. The Subcommittee on Science, Research and Technology is today joining with the Subcommittee on Investigations and Oversight of the Science and Technology Committee, which is chaired by Congressman Gore, in sponsoring this hearing on a topic that is on everyone's mind, that goes to the fundamental way of our view of how humanity can make progress with its mind, literally.

This hearing is a followup to our subcommittee's March 1982 hearing, which also started to examine the possible effects on scientific research and scientific exchange brought about by new restrictions proposed for the purpose of national security on the exchange of scientific knowledge. We are keenly interested in how such restrictions will affect the vigor and the vitality and the openness of the environment that is clearly necessary for progress in science and technology.

All of us clearly share the goal of national security. With the rapid progress of science comes an increase in sophistication of military weapons and the means to design and manufacture them. As a result, new technology can be used for both civilian and military purposes. These facts are unavoidable and they have ramifications for our national security inasmuch as our adversaries can apply developments made in our society to their own weaponry.

At the same time, science clearly requires an open environment in order to flourish. Productive academic research depends on free exchange in the academic and scientific communities. Any restrictions on this kind of open communications must be seriously—I underscore seriously—questioned. Whether free scientific exchange and national security are truly inconsistent is a question that we should certainly stop and think about before we rush down a road that would limit communication in this area.

We are pleased to welcome a very distinguished array of witnesses from the major interested parts of our society—universities, industry, and government. All of these witnesses have unique perspectives on the effects on scientific communication that are raised when it comes to national security considerations. The academic witnesses come to us from the Nation's most prestigious universities, and we appreciate very much being able to have access to their views and their personal attention on this question in the record that this committee develops. The witnesses from industry will provide us with an overall discussion of this issue and in particular their views of how Government policy affects commercial trade and technology transfer. Finally, we have a panel of witnesses representing the various departments of Government in-

volved who will be able to discuss how they intend to deal with scientific communication and national security.

At this point I would like to ask unanimous consent of the other members to include in the record several articles that set out the background and some of the considerations involved in this issue for purposes of completing the record. Without objection, we will receive those insertions.

[The articles mentioned above follow:]

Scientific Communication and National Security in 1984

Mitchel B. Wallerstein

Summary. The federal government's concern about maintaining the lead of the United States over the Soviet Union and its allies in military critical technology has led it to attempt to control unwanted technology transfer. Its attempts have extended to control of open scientific communication as well as the transfer of physical devices and blueprints. In 1982, the Corson Panel (an independent ad hoc committee) reviewed the evidence on the costs and benefits of controls and suggested guiding principles for government policy. This article examines the major policy developments since the Corson Panel completed its work. The stringency and the reach of government restrictions, either proposed or in force, go considerably beyond the panel's recommendations.

In recent years, U.S. national security has come to depend increasingly on lead time over its adversaries in areas of high technology—that is, areas in which technological progress is closely related to advances in basic science. Many of these technologies (for example, high-speed electronics and computer-based encryption techniques) have commercial as well as military applications. This has led some in the past and current administrations to fear that the open U.S. research community could become a source of militarily significant technology to the Warsaw Pact.

Such concerns were reflected both in policy proposals and public pronouncements aimed in part at the scientific community. Public statements in early 1982 included warnings by senior officials in the Department of Defense, the Department of Commerce, and the Central Intelligence Agency that Soviet military intelligence might find easy access to sensitive information through what one called the "soft underbelly" represented by the American academic community (*1*).

Conflicting Perspectives on the Problem

There are sharply differing views within our society regarding the extent of technology loss and the best solutions to the problem. Some interests speak with a louder and more effective voice than others in terms of the formulation of Administration policy, recognizing that there is a good deal of overlap in the emphasis accorded by each.

Clearly, what lies at the heart of public debate is concern over the loss of military advantage the United States might suffer if it does not block the efforts of the Soviet Union and its allies to gain access to Western science. Some who are concerned with national security believe the speed and seriousness of this technology transfer require new policies and reassessment of current regulations. The concern here is really twofold. First, by targeting Western research, the Warsaw Pact countries avoid a large part of the massive R & D investment the United States has committed to the development of sophisticated military systems. Second, the nature of the research process in nonclassified settings has changed, with the result that universities in particular are now becoming increasingly attractive targets for foreign intelligence efforts. Those sharing this concern argue that the imposition of limited controls is preferable to classification, which would remove such work entirely from the campus. They suggest that, when universities choose to accept the presence of defense-related research on campus, for whatever mix of intellectual and economic motivations, controls must be considered part of the price.

A second perspective focuses on the critical importance of maintaining vigorous, open scientific communication both within the borders of the United States and across international boundaries. According to this view, even limited restrictions on the free flow of information affect feedback, delay the discovery of errors and duplication, hinder critical evaluation of scientific efforts, and, as a result, undermine the pace of scientific discovery. The price of achieving short-term security by restricting the communication of ideas and information would be the pace and effectiveness of both our research effort and the transfer of that research into application. This perspective argues, in sum, that secrecy about existing knowledge can never replace the development of new ideas as a means of protecting national security.

Those adhering to this view also suggest that openness pays dividends of other kinds. For one thing, U.S. efforts to limit the flow of information by restricting scientific exchanges with the Soviet Union inevitably will limit the flow of information from them to us. Not only does American science benefit from these interactions, but it can also be argued that for intelligence purposes they help gauge accurately the state of Soviet scientific advancement.

A third perspective focuses on the educational impacts of restrictions on access to and dissemination of scientific and technological information. Here again there are two separate arguments. First, those who provide advanced scientific and technical training point out that it is functionally impossible to separate completely education from research activities. Moreover, if the only experience a young scientist or engineer gains is in the classroom, rather than the laboratory, the next generation of American investigators will be substantially less prepared to maintain the superior levels of productivity and achievement that have characterized the U.S. scientific effort since World War II.

But there is another important dimension to the educational perspective: the cost to the U.S. academic system of excluding foreign nationals from sensitive areas of science and technology. The number of foreign students in higher education in the United States increased substantially during the 1970's, at both the undergraduate and graduate levels. Among the factors underlying this trend were increased foreign demand and increased recruitment of foreign students by U.S. institutions in order to augment domestic enrollment (Fig. 1). The data

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are even more striking at the postdoctoral level (Fig. 2). The postdoctoral sector is particularly significant because it is a major source of junior faculty and research talent in many American universities.

A fourth major view is that expressed by private industry. Many leaders of U.S. technology-based industries have argued that if industries are to adapt to rapidly changing business conditions, they must have access to scientific and technological information from all parts of the world. Beyond the loss of information, industrial leaders express concern about other economic impacts resulting from a lack of openness, including regulatory costs, loss of sales, loss of reliability as a trading partner, and reductions in the pace of innovation.

A fifth voice in the debate may be characterized somewhat broadly as the constitutional and cultural perspective. Many concerned about the continued vitality of the American political system believe it can flourish only in an atmosphere of openness. First, they point out that fundamental constitutional questions may be raised when the government seeks to restrict the rights of citizens to speak or to publish. It is argued that freedom of speech is not just a legal right, it is essential to the maintenance of an informed electorate. Second, it is suggested that visits by Soviet and East European scientists expose them to the U.S. culture and political system which, over time, may contribute to political and social change within the Warsaw Pact.

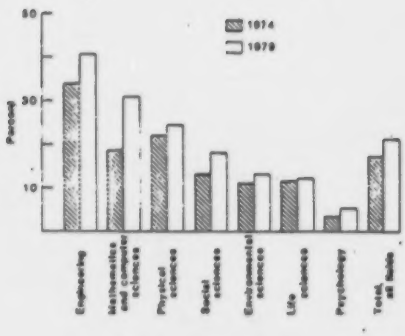

Fig. 1. Percentage of foreign students in full-time, graduate science and engineering programs in doctorate-granting institutions, 1974 and 1979 (16).

Key Findings and Recommendations of the Corson Panel

In spring 1982 discussions between representatives of the National Research Council and the DOD led to the establishment of an ad hoc panel of the Committee on Science, Engineering and Public Policy (COSEPUP), chaired by Cornell University president-emeritus Dale R. Corson. The panel included scientists, former defense and national security officials, and research administrators in industry and universities (*2*). Its mandate was to examine the evidence of technology leakage and methods for controlling it, and to seek policy measures by which the competing national goals of national defense and intellectual freedom could be accommodated satisfactorily.

After reviewing evidence on the benefits and costs of control measures, the panel concluded that a national strategy of "security by secrecy" would weaken American technological capabilities, because there is no practical way to restrict international scientific communication without also disrupting domestic scientific communication. A national strategy of "security by accomplishment"—one that emphasizes protecting the U.S. technology lead by promoting scientific productivity—has far more to recommend it (*3*).

The panel heard extensive briefings by the intelligence community, some at high levels of classification. While noting that the available evidence left much to be desired, the panel reported that it had found no case of significant damage to security associated with research dissemination (*3*, pp. 13 and 41). The panel also added two caveats. First, it observed that the evidence on leakage and the associated damage to U.S. security was still only fragmentary and anecdotal, in part because the problem had only recently been identified (*3*, p. 14). Second, it pointed out that Soviet intelligence efforts were extensive and that universities and other research sites were indeed targeted. It also noted (but took no position on) intelligence community arguments that research facilities are likely to be more heavily targeted in the future (*3*, p. 21).

The panel suggested that the class of research information of greatest potential concern is not the explicit findings in research reports but rather know-how—the detailed understanding of equipment use or operational procedures normally gained only by direct participation in a research project (*3*, p. 42). It follows that protection of sensitive research information is achieved better by preventing sustained access to research projects than by preventing dissemination of written research reports.

The Corson Panel examined five types of control mechanisms: (i) classification, (ii) export control regulations, (iii) controls on foreign visitors, (iv) restrictions on government contracts, and (v) voluntary prepublication clearance. Its general review of these mechanisms led the panel to two broad conclusions:

1) Where controls are deemed necessary, the government should use contract restrictions in preference to export control regulations. The contract mechanism has the advantage of informing a researcher of his or her obligations in advance while leaving application in the hands of the most technically qualified government personnel. Export controls, devised for controlling the movement of tangible objects, are ill-suited to the control of information flow.

2) The government's effort is uncoordinated and spread too broadly across too many diverse technologies to be practicable. An effort spread this thin cannot be effectively administered, and it raises unnecessary fears among researchers working in areas with no military relevance. The panel suggested that the government adopt a strategy of building "tall fences around narrow areas"; contract controls, for example, should be restricted to a few gray areas that justifiably cannot be either classified or completely open. It defined such technologies as those in which all of four criteria apply (*3*, p. 49).

- the technology is developing rapidly, and the time from basic science to application is short;
- the technology has identifiable direct military applications; or it is dual-use and involves process or production-related techniques;
- transfer of the technology would give the U.S.S.R. a significant near-term military advantage; and
- the United States is the only source of information about the technology, or other friendly nations that could also be the source have control systems as secure as ours.

The Corson report was released on 30 September 1982, and it was received

favorably by top Administration officials, university administrators, and other members of the U.S. science policy community.

The Situation in 1984

More than 18 months have elapsed since the Corson report was issued. Much of the hope that surrounded its release has faded and there have been at least four attempts to formulate a new policy:

1) An interagency review of the Corson report's implications has yet to be completed. The effort began with National Security Study Directive 14-82 (now renumbered as NSSD 1-83), which was signed by President Reagan and issued by then National Security Advisor William Clark in December 1982. The terms of the review have twice been altered, and there have been multiple changes of personnel at the Office of Science and Technology Policy (OSTP), which is responsible for coordinating a major section of the report. In addition the study has been conducted at the classified level without the benefit of outside input. It is not known how the product, reportedly near completion, compares in scope or substance with the effort originally requested by the President. OSTP officials see an advantage in the release of some sort of unclassified document, but they are unsure as to either the date of its public availability or its comprehensiveness.

2) Given the delays in the interagency policy review, the Department of Defense (DOD) has moved to complete an internal policy review that was begun in 1981. Accordingly, a Steering Committee on Technology Transfer was established within DOD to focus on contracts, visa controls, emerging technologies, scientific conferences, publications, and rules for exemption to the Freedom of Information Act. The work of the Steering Committee and its subpanels has now been largely completed and its recommendations are being implemented.

3) A provision included in the 1984 Defense Authorization Act permits the Secretary of Defense to protect certain kinds of unclassified technical data in the possession or under the control of the DOD that otherwise would be subject to release to foreign nationals under the terms of the Freedom of Information Act. Additional proposals have been circulated within the DOD to seek broader authority to protect sensitive technical data produced by other federal agencies

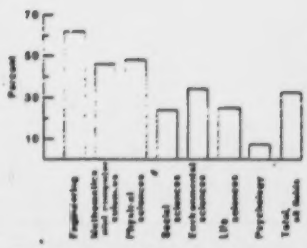

Fig. 2. Percentage of foreign postdoctoral researchers in science and engineering programs in doctorate-granting institutions, 1979 (16, p. 21).

of Energy) by facilitating their transfer to DOD control.

4) A Presidential directive, "Safeguarding National Security Information" (NSDD 84), was issued in March 1983. That directive would have required both government officials and those under contract to the government with access to sensitive compartmented information, which is information classified at levels above top secret, to submit for prepublication clearance anything they write that bears upon national security matters. The directive was withdrawn in February 1984 after substantial opposition arose in the Congress and among the general public.

While the various intra- and interagency policy studies have been under way, a series of incidents have occurred over the past 16 months similar to those that provided the original impetus for creation of the Corson panel. The principal distinction between now and the pre-Corson environment is that most of the incidents relate to the withdrawal of papers from meetings, rather than the denial or restriction of visas or other restrictions.

The Development of Controls

Since the early 1940's, the federal government has added steadily to the means by which it can prevent—or at least slow—the loss of militarily sensitive scientific information. For example, the government has the authority, established through a series of executive orders, to impose security classification on sensitive research conducted by its own employees or undertaken by private parties at public expense. The Executive Branch has also been assigned a substantial amount of legislative authority over the years through which it can attempt to control all aspects of scientific communication.

The Atomic Energy Act of 1946, for example, precluded public dissemination of most of the results of the Manhattan District Project or subsequent atomic research, particularly through a "born secret" provision that automatically classifies research on atomic energy at its creation. The government has also been able to use the authority vested in export control legislation to limit the release of products, processes, and technical data to potentially adversary nations. The Export Control Act of 1949, which has been renewed since 1969 as the Export Administration Act, required the Department of Commerce to prevent the export of goods that might enhance either the economic or military potential of communist countries. The Export Administration Act is implemented through the Export Administration Regulations and through a comprehensive list of products and processes known as the Commodity Control List. Since 1979, the Department of Commerce administrators have also relied for guidance on the Militarily Critical Technologies List, which is prepared by the DOD and based on a 1976 report of the Defense Science Board, commonly called the Bucy report (4).

Another method of controlling the export of security-related data is the Arms Export Control Act of 1976. This Act is implemented by the Department of State through the International Traffic in Arms Regulations. These regulations control the export of military systems, including technical data relating to the "design, production, manufacture, repair, overhaul, processing, engineering, development, operation, maintenance or reconstruction . . . of implements of war on the U.S. Munitions List" or "any technology that advances the state of the art or establishes a new art in any area of significant military applicability" (5).

In order to control the movement of militarily sensitive goods at the international level, the Coordinating Committee for multinational export controls (CoCom) was established by informal agreement in 1949. It comprised all the NATO countries except Iceland and Spain, plus Japan. CoCom has provided a forum for the voluntary coordination of trade controls on exports to the Warsaw Pact countries. The United States is currently engaged in efforts to strengthen the effectiveness of the CoCom mechanism.

An Update of the Key Issues

Evidence on the extent of technology leakage. Knowledge about technology leakage and its effects on national security has not changed significantly in the 18

months since the Corson Panel was briefed by the U.S. intelligence community (6). In recent months the principal activity has been the identification of the ways in which technology leakage can occur so that a comprehensive control effort can be fashioned. No major initiative has been undertaken to better characterize the relative importance of sources, channels, or types of information that leaks out or the relative significance of scientific communication within the large picture. The intelligence community reports no cases during this period in which loss through the U.S. scientific community has led to identifiable damage to national security. However, intelligence officials remain concerned about the small percentage of Soviet intelligence acquisitions that involve the American research community.

Classification controls. There is now better information on the extent to which military research is classified or otherwise restricted. As part of the report of its subcommittee on publications, the DOD Steering Committee on National Security and Technology Transfer determined how publications in federal information centers were classified or disseminated in terms of their subject area or source (Tables 1 and 2).

The data support the contention that universities are responsible for less sensitive research than is done in other settings, no matter what field of technology is involved. The study also found that all classified reports from universities and approximately 50 percent of the limited reports from universities were generated in off-campus facilities affiliated with the universities. Meanwhile, through Executive Order 12356, issued in April 1982, the Administration changed the thrust of its classification policy, stating that restrictions are to be imposed in all cases where reasonable doubt exists about the need for classification. It also expanded the number of categories of potentially classifiable information and made it possible to reclassify information previously made public.

Export controls. The Export Administration Act, and the attendant Export Administration Regulations (EAR), remains the principal regulatory instrument for controlling the flow of sensitive technical data, particularly that of a proprietary nature across our borders. The Export Administration Act came up for renewal during the first sessions of the 98th Congress. Bills were passed in both Houses early in the second session, with the Senate version tending to be more restrictive than that of the House. A conference version of the Export Administration Act of 1984 is expected before the end of the current session.

While the language of the new export act has been debated, the Administration has proceeded with vigorous efforts to control unwanted technology transfer. It can be stated that, in general, the Department of Commerce presently considers scientific communication to be a relatively small—albeit significant—aspect of the overall technology control problem. Since 1982 the EAR have not been invoked to prevent the dissemination of the results of academic research. On the other hand, modifications to the technical data regulations under consideration for incorporation into the EAR could significantly alter this situation. If implemented, they would eliminate the general licensing exemption granted to some "scientific and education data." They would also require a validated license for the export of virtually all "critical technical data," a new term identified in the draft wording, which is not publicly available. Since the definition of "export" in this draft includes presentation of papers at symposia where foreigners were present, the hiring of a foreign researcher, and so on, the proposed rules, if adopted, would have a significant impact on U.S. scientific intercourse.

The Administration has also stepped up its export control enforcement effort, principally through two channels. The first, Operation Exodus, is an effort by the Customs Service since late 1981 to spot-check high-technology goods being readied for shipment. It has resulted in the detainment and seizure of some 2300 foreign-bound shipments worth approximately $149 million and eventual indictments in 221 cases, only 28 of which involved so-called dual-use technology (7). The second effort to enforce controls involved creation of a new post within the Department of Commerce, known as the Office of the Deputy Assistant Secretary for Export Enforcement, which referred 37 dual-use technology export cases to the Justice Department for prosecution in fiscal 1983 (7). This two-track approach reflects uncertainty between the Customs Service of the Treasury Department and the Export Administration of the Department of Commerce over which agency has lead responsibility for export enforcement.

The other principal export control

Table 1. Distribution restrictions on DOD reports by source, 1979 through 1983 (13).

Source	Total	Classified (%)	Limited (%)	Public (%)
DOD laboratories	61,694	12	44	44
Universities	23,119	1*	4	95
Industry	32,806	21	35	44
Nonprofit	5,609	17	15	68
Total	123,228	13	33	54

*Generated at research institutes associated with universities.

Table 2. DOD reports withheld from public release, by subject (13).

Field	Total	Classified (%)	Limited (%)	Public (%)
Missile technology	2,524	57	32	11
Ordnance	6,740	32	47	21
Military sciences	8,099	38	33	29
Navigation, communication, detection and countermeasures	13,490	40	28	32
Aeronautics	5,082	13	53	34
Propulsion and fuels	3,252	14	48	38
Space technology	905	17	44	39
Nuclear science and technology	1,259	24	34	42
Energy conversion (nonpropulsive)	1,055	3	54	43
Electronics and electrical engineering	12,424	3	50	47
Materials	5,643	1	46	53
Methods and equipment	2,288	3	42	55
Agriculture	82	1	44	55
Mechanical, civil, industrial, and marine engineering	9,284	5	35	60
Biological and medical sciences	10,093	1	32	67
Physics	12,812	6	25	69
Behavioral and social sciences	10,529	2	20	78
Earth sciences and oceanography	4,671	1	21	78
Atmospheric sciences	3,078	1	16	83
Chemistry	4,042	—	14	86
Astronomy and astrophysics	584	—	13	87
Mathematics	5,292	—	5	95

mechanism is the Arms Export Control Act and the attendant International Traffic in Arms Regulations (ITAR). Revision of the ITAR, which has been pending for more than 2 years, still has not been completed, although a draft of the revised regulations is now said to exist. A likely target period for release of a new ITAR is mid-to-late 1984. The ITAR is administered by the State Department on the basis of the Munitions Control List, which is maintained by the DOD. However, there appear to be no instances in which the ITAR has been applied to written or oral scientific communication since the release of the Corson report.

Controls on foreign visitors. In May 1983, after an interagency review, Under Secretary of State William Schneider announced a new visa policy for handling cases of individuals suspected of technology acquisition. Schneider essentially reaffirmed that the existing visa law can and should be used to limit the loss of information obtained by foreign visitors. Moreover, he indicated that action may now be taken on a visa solely on the basis of a visitor's potential to be a source for technological loss. Therefore, depending on the nature of the risk identified, an applicant may be (i) denied a visa, (ii) offered a conditional visa, or (iii) given an unconditional visa. In cases of conditional visas, the restrictions may be imposed either by the relevant department or by the Immigration Service of the Department of Justice—outside of the visa process—as a condition of entry.

The State Department's principal concern is commercial trade visits, with only secondary attention paid to those involved in academic research. Again, depending on the assessment of the risk involved, a sponsor may be asked to modify a visitor's program, or alternatively, the visitor's freedom to travel may be restricted. Because the Visa Bureau does not track technology transfer cases per se, it is not possible to provide a quantitative assessment of scientific visits approved, denied, or made conditional. However, Table 3 provides an indication of the trend in advisory recommendations made between 1981 and 1983 by COMEX, the interagency Committee on Exchanges. This period may be somewhat anomalous, due to rising tensions with the Soviet Union and East Europe over Poland and other matters, but the data reveal (i) a decline in the total number of cases reviewed, (ii) a slight decline in the percentage of cases in which significant concern was expressed, (iii) a decline in the percentage of cases recommended for program denial, and (iv) an increase in the percentage of cases recommended for program modification. COMEX recommendations are not necessarily adhered to by the State Department, but they prevail in a majority of the cases.

Table 3. COMEX recommendations for visiting scientists' programs, 1981 to 1983 (*14*).

Programs recommended	1981	1982	1983
For approval	92	56	33
For approval with modification	225	57	133
For denial	55	35	28
Total	372	148	194

An interesting aspect of the visa and scientific exchange matter involves the People's Republic of China. The COMEX data reveal that between 11 and 25 percent of the cases from 1981–1983 in which significant concern about technology loss was expressed by the committee involved Chinese students or scientists. But, because visa and export control policies toward the People's Republic have been liberalized substantially, none of the COMEX recommendations for program denials involved the Chinese. The programs of some visiting Chinese were, however, modified.

Contract controls. The Corson Panel recommended that where controls on unclassified scientific information are warranted, they can best be accomplished by means of a priori contract constraints. This mechanism was examined by the DOD Steering Committee on National Security and Technology Transfer, and a new policy has emerged on "international transfers of technology, goods, services and munitions" (DOD directive 2040.2) (*8*). This directive articulates a number of new mechanisms for establishing standard definitions of what is militarily sensitive and for resolving appeals of contractually imposed restrictions. It also establishes the Panel on International Technology Transfer, as the highest level appeal mechanism for resolving differences within the DOD on technology transfer policy, and it creates two subpanels: (i) Export Control Policy—a first-level appeal structure for resolving differences on export control policy matters, and (ii) Research and Development—a first-level appeal structure for resolving differences on technical standards, definitions, and the dissemination and exchange of technical information, including appeals of "technology transfer research cases."

With regard to sensitive research undertaken in academic settings, the DOD Steering Committee has made a number of additional recommendations. First, it has clarified its policy on review of research papers produced by DOD contractors, distinguished by budget category and the nature of the research (Table 4). The point of these policies is to give the researcher written notice of review procedures before he or she signs a DOD contract.

Two aspects of Table 4 merit special attention: (i) the 60-day prior review requirement for basic research is more restrictive than recommended by the Corson Panel, which called for simultaneous review by the publishers and DOD, and (ii) the 90-day prior review and right to require changes for sensitive exploratory research or development are also far more restrictive than the Corson Panel's recommendation of simultaneous review for both basic and applied research.

In addition, the DOD Steering Committee has recommended the permanent implementation of a series of six dissemination-control stamps, already approved on an interim basis by Secretary of Defense Caspar Weinberger, that clarify the standards used in circulating unclassified documents produced through DOD contracts (or at government laboratories) and held by the Defense Technical Information Center (DTIC) and other secondary distribution facilities (*9*).

Finally, COMEX is updating an existing DTIC database in order to inform researchers of each other's work and to determine quickly the number and type of DOD contracts in force on a given university campus plus their level of classification or restriction.

Voluntary prepublication review. An agreement for voluntary submittal of papers for simultaneous review by the National Security Agency (NSA) and professional journals, developed by the Public Cryptography Study Group of the American Council on Education and the NSA, appears to be working in a manner that is reasonably satisfactory to all parties. The NSA reports that 200 papers have been submitted for review since completion of the agreement. Of this total, nine papers have been challenged, six have been modified, and three have been withdrawn. Pursuant to the agreement, a six-member appeals committee has been established, consisting of four academic researchers and two former NSA officials. To date, there have been no appeals of the NSA review decisions (*10*).

Implementation of gray area criteria. Perhaps the most important recommen-

Table 4. Review policy for research papers produced by DOD contractors (*15*).

Budget items	Nonsensitive research	Sensitive research
Basic research*	Simultaneous submittal to contract officer and to publisher. DOD has no right to require changes or to restrict publication.	Manuscript must be submitted to contract officer 60 days prior to submittal to publisher. Researcher retains option of whether or not to publish.
Exploratory research and advanced technological development†	Same rules as for basic research.	Manuscripts must be submitted to contract officer 90 days prior to submittal to publisher. DOD retains the right either to require changes before allowing publication or to block publication outright.

*DOD budget category 6.1. †DOD budget categories 6.2 and 6.3.

dation of the Corson Panel concerned the need to build tall fences around narrowly circumscribed technologies that could be identified as meeting the four principal criteria set forth in the report. Pending the public release of the interagency NSSD report, which was coordinated by the OSTP, it is impossible to determine with certainty the extent to which these recommendations have been adopted as official policy.

There are indications, however, that the government is moving toward the adoption of a broader approach than was recommended by the Corson report. Consider the following factors: (i) there has been little progress in streamlining the Militarily Critical Technologies List; (ii) a new, unclassified Militarily Significant Emerging Technologies Awareness List (METAL) is being created that will identify for purposes of monitoring certain frontier technologies just appearing on the horizon but not yet embodied (*11*); (iii) the definition of "threat assessment factors" proposed to the DOD Steering Committee on National Security and Technology Transfer for identifying militarily significant emerging technologies are substantially more comprehensive than the Corson Panel criteria; and (iv) continuing efforts are under way within the Coordinating Committee for multinational export controls to identify additional technologies that are to be proscribed or restricted for export to Warsaw Pact countries.

Conclusions

This review of the current status of scientific communication and national security suggests three major conclusions.

1) The government has not found it possible to act in a manner compatible with the major principles set forth in the Corson report. Although the DOD appears to be implementing the panel's recommendation that the best form of control is the research-funding contract, both the stringency and the reach of restrictions either proposed or in force go considerably beyond the panel's recommendation. Moreover, if the draft wording for new technical data regulations were incorporated into the EAR, then export controls could come to supplant DOD-imposed contractual restrictions as the principal mode of control contrary to recommendations of the Corson Panel.

2) The continuing lack of effective government-wide coordination raises important risks, including (i) disparate agency policies that do not adequately balance national goals, (ii) wasteful allocation of national resources among programs of varying effectiveness, and (iii) confusion and skepticism in the research community. Given the successive delays in the National Security Council review, policy initiative has reverted back to the individual agencies (most notably DOD), whose missions typically reflect only one among the many relevant national objectives. Once put into place, these uncoordinated initiatives will be difficult to adjust. The government's lack of central coordination also represents a missed opportunity to set reasonable priorities among the many offices (OSTP counted 44 of them) responsible for addressing the many parts of the technology transfer problem. There is a danger that the lack of effective government-wide coordination will undermine the perceived legitimacy of government programs among the research community.

3) There is little progress toward an objective understanding of the technology leakage problem and the effects of control measures. This research failed to demonstrate any improvement in knowledge about the actual effectiveness or adverse effects of control on scientific communication.

One feature that makes the policy dilemma in this area particularly difficult is that the costs of being wrong, which are potentially great, accrue only after a delay and in ways that are difficult to measure accurately in the short term. If U.S. controls on scientific communication are too lax, the extensive Soviet intelligence effort may obtain at relatively low cost information not otherwise accessible. Even then, however, it may be difficult to determine precisely how the transferred data have contributed to the Soviet military posture. On the other hand, excessively tight controls may have effects that, while subtle and indirect, are also pervasive. Perhaps the largest risk in this regard is the long-term changes that controls are likely to cause in the demographic distribution of scientists and engineers among the various disciplines and subfields.

The threatened or actual government intervention has already had an impact on the number of papers put forward for publication or presentation at conferences in certain fields (*12*). If the present climate of uncertainty continues, we may witness an increasing migration of the best minds away from those areas of science and engineering where controls are (or may be) imposed—the very fields where new talent is most critical to U.S. technological lead time. Furthermore, if the United States acts to restrict further the flow of people and ideas in frontier areas of science and technology, other advanced industrialized countries may find it necessary to do the same. In this respect, to the extent that U.S. national security continues to rely on technological superiority, by disrupting the invisible colleges, the channels of informal communication that speed the pace of innovation and scientific discovery, the nation may risk sacrificing its best hope for continued long-term security in the belief that controls are necessary to maintain short-term strategic advantage.

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Increased National Security Controls on Scientific Communication

HAROLD C. RELYEA

During the past few years, efforts have been underway to increase national security controls on scientific communication. In many regards, the situation is a repetition of a policy conflict that occurred with the onset of the Cold War almost forty years ago. The integrity of science will not be enhanced by increased national security controls on scientific communication. Designed to impede our adversaries in the international arena, such restrictions can severely curtail U.S. scientific achievement and progress, with consequential harm to the intellectual and economic, as well as military security of the nation. Both the historical background of this issue and the current controversy are explored here.

The experience of World War II convinced the nation's leaders of the value of scientific enterprise for defending the country. The subsequent Cold War, however, distorted this recognition. There seemed to be no limit to the number and kinds of contributions of science that were perceived by government officials to be vital to the security of the United States and, therefore, in need of protection to restrict their availability. One prominent scientist, Dr. Lloyd V. Berkner, described the situation for a congressional subcommittee in March, 1956, in the following words:

> . . . as society generally has become deeply dependent on technological development, so too has the military organization increased its dependence on science and technology.
>
> Initially, at least, it appeared reasonable that the military restrict the exchange of ideas having military implications on the ground that to permit the free flow in information would hand the enemy our developmental achievements "on a platter."
>
> . In the modern world, however, all the important ideas of science have military implications and, under our present policies, must therefore fall inevitably under the cloak of military secrecy.[1]

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Many scientists, both for reasons of principle and function, were not happy with this state of affairs. The free dissemination of information and open discussion were, and remain, essential parts of the scientific process. Ideally, findings should be publicly and generally available, and subject to criticism, improvement, and, if warranted, rejection. Inevitably, research and, consequently, scientific progress, suffer from the imposition of secrecy. This point was well stated by Dr. Vannevar Bush in his 1945 report to the President concerning a program for postwar scientific enterprise. It was his observation that, "A broad dissemination of scientific information upon which further advances can readily be made furnishes a sounder foundation for our national security than a policy of restriction which would impede our own progress although imposed in the hope that possible enemies would not catch up with us."[2]

In his 1956 congressional testimony, Dr. Berkner was much in agreement with Bush's perception. He offered the view that, since the end of World War II, "we have steadily lost ground relative to our competitors until now there is serious question whether the United States actually retains leadership in certain critically important fields of military technology." This situation had developed, he said, primarily because of "the slowing down of our own technological achievement." He then stated that, in his opinion, "an important aspect of this loss of supremacy in certain vital fields of technology stems from our present widespread practice of technological secrecy, consequent clearance and security practices, compartmentalization of science and technology, and restrictive practices exercised over science and scientists."[3]

Relief from the kinds of secrecy and security controls that Dr. Berkner was criticizing in 1956 came in the 1960s largely because Cold War anti-communism gave way to international trade and foreign policies seeking greater cooperation with the Soviet Union and its Warsaw Pact allies. Among the diplomatic and commercial ventures pursued with a view to easing tensions between the United States and the Communist bloc nations were various exchanges of scientific personnel and sharings of technological knowledge. As the 1970s passed into history, however, old anxieties began to mount. Soviet military equipment, advisers, and Cuban troops were landed in Ethiopia in support of the government's efforts to suppress a rebellion in Eritrea. In spite of condemnations and protests from both Congress and President Carter, the Soviet Union vigorously pursued the prosecutions and punishments of prominent dissident intellectuals. The United States next discovered that up to 20 advanced Mig-23 jets had been based in Cuba. Some months later it was learned that a Soviet combat brigade was stationed in Cuba as well. And in December, 1979, the era of "detente" came to an abrupt end when the Soviet Union invaded Afghanistan.

During the final months of the Carter Administration, renewed U.S.-Soviet tensions prompted the curtailment of various cooperative activities by the two super powers, including a number of scientific and technological exchanges. With the arrival of the Reagan Administration, both American domestic and foreign policy became permeated by a more strident anti-communist attitude, manifesting itself in increased defense spending and preparations, expanded internal security procedures, broadened official secrecy arrangements, more vigorous enforcement

of laws restricting the availability and communication of information or goods of possible value to a hostile nation, and pursuit of new authority for more strictly controlling the acquisition of American technological commodities and scientific knowledge by foreign countries. These efforts were justified in terms of "national security." In many regards, they are a return to the Cold War policies and practices of the 1950s. And to the extent that they impinge upon the process and products of science, they pose a threat about which Dr. Bush and Dr. Berkner—and history—have gravely warned.

SCIENCE AND SECURITY

Current efforts to exert greater governmental control over scientific communication for reasons of national security are premised on two general considerations. The first of these concerns international relations. As tensions between the U.S. and the Soviet bloc increase, it is in the self-interest of the United States, it is argued, to limit the availability of certain scientific information. This might be accomplished through more stringent application of export controls or, as was done in the aftermath of the Soviet invasion of Afghanistan, the official curtailment of the level of cooperative activity under scientific exchange agreements. The kinds of scientific information to be so restricted depends upon government interpretation of "national security."

The second consideration is a matter of what might be called responsible guardsmanship. Scientists throughout the private sector of American society—in both the academic and business-industrial communities—are contributing to a "hemorrhage" of technology to the Communist bloc, it is argued, by openly communicating sensitive scientific information in publications, in classrooms, and at professional conferences. The extent to which such material is "sensitive" in a national security context is a judgment that the government seemingly would like to reserve to itself. Scientists are urged to exercise restraint, to seek government counsel when in doubt about an open communication of possibly sensitive information, and, in some fields of research, such as cryptography, formal review procedures are prescribed.

Although American scientists are willing to concede that transfers of scientific and technological knowledge to the Soviet Union and its satellites have occurred, the vast majority of these leakages seemingly are attributable to unauthorized or illegal sales by businesses, espionage, theft, or laxity on the part of U.S. allies who do not properly protect American science and technology located within their borders. Moreover, scientists' objections to increased government control of their professional communication should not imply that they underestimate the external dangers facing the United States, are unmindful of the need for limited official secrecy or security safeguards, or are unaware of the potential military applications of their research and discoveries. Indeed, in taking issue with new national security limits on scientific communication, American scientists appear to be neither politically naive about nor unappreciative of the position of their country in the continuously tense international arena. In addition, they are disturbed about the effect of such increased restrictions on the scientific process,

troubled by the vague nature of the controls being advocated by officials, and, not the least of their worries, concerned about the pragmatic effect of new national security limitations on scientific and technological progress and achievement in the United States.

BASIC CONCEPTS

In addition to threatening the integrity of science, understood both as a process and a body of knowledge, increased national security controls on scientific communication pose some other problems which might best be considered at the present time in terms of four basic operative concepts. In brief, what is being increased, expanded, or intensified; what is the basis for this action; and what is to be affected?

Controls

In the policy context under discussion here, the concept of "controls" has at least four dimensions. With regard to *strategy*, the regulatory authority of the government might be enhanced by more vigorously and stringently applying existing control law, by appropriately amending existing control law, by creating new control law, or by realization of some combination of these possibilities.

With regard to *form*, the policy instrument enhancing the regulatory authority of the government might be a published statute, presidential directive, or agency regulation. However, it also might be a security classified order or interpretive memorandum not directly available to the public.[4]

Next is the matter of the *process* by which the policy instrument enhancing the regulatory authority of the government is created. Statutes are a product of the open hearings and debate of Congress which allow a variety of points of view to be aired. New agency regulations usually are subject to a public notice and comment requirement.[5] Although executive orders and presidential proclamations generally are published in the *Federal Register* (executive orders can be classified),[6] there is no legal requirement that any presidential directive or policy memorandum be subject to a public comment period.[7] Such instruments can be developed in isolation and issued without consultation with anyone other than the President's immediate advisers.

Finally, there is the element of *scope*. The enhanced regulatory authority of the government may be confined to its own immediate realm—agency employees, contractors, grantees, and derivative goods and information—or may be more generally applicable to the public. Leaving content or substance considerations aside for the moment, the nature or form of the policy instrument may be of some consequence. Executive orders and similar such presidential directives usually have been used to determine matters internal to the government, but there have been exceptions to this practice.[8] Law affecting the general public usually is established by statute. The Constitution not only explicitly authorizes the statutory process of lawmaking, but also prescribes certain limits on the legislative powers of Congress. Agency regulations are expected to be in conformity with the statutes

they implement. Federal courts, on occasion, have struck down Executive Branch regulations and directives and invalidated actions taken pursuant to them. Similarly, Congress, in exercising its legislative authority in an area specifically entrusted to it, has repealed agency regulations and presidential orders. However, the legislature may not divest the President of a constitutional function by legislation.

In the American tradition of limiting the powers of government, there is much to be said for an approach to increased controls on scientific communication which seeks minimal new official regulatory authority. Viewed in terms of a hierarchy of actions, a first consideration might be to upgrade the enforcement of existing control law. The next higher alternative would be to amend appropriately current control law. A final possibility might be to create new control law, bestowing upon the government regulatory authority of a kind and/or regarding matters not previously attained. Each of these efforts should be designed to address specific problems or weaknesses, should be pursued in a manner which would permit public comment and the expression of views about the proposed policy before a final determination is made, and should result in a clear, publicly available expression (statute, regulation, directive, etc.) of the new policy.

National Security

The basis for increasing government control of scientific communication is for reasons of "national security." There seemingly should be both a *substantive* and *administrative discretion* dimension to this concept. However, as an official with the National Security Council noted some years ago, it is "a point of view rather than a distinct area of governmental responsibility."[9] As a result, there is no substantive understanding of the term in statutory law.[10] The referent appeared about 390 times in the 1970 edition of the *United States Code*, with additional inclusions in the uncodified statutes. A little more than 100 of these entries pertained to government institutions such as the National Security Agency or the National Security Council. Another two score were section headings or cross-references in the *Code*. Another two score referred to the National Security Act. Slightly more than 240 of the remaining citations, however, were descriptions of a policy condition granting the Chief Executive extensive discretionary power—e.g., "for reasons of national security," "for purposes of national security," or "in the interest of national security."[11]

At best, "national security" is a phrase of convenience for lawmakers throughout the Federal Government, yet rarely is it defined or meaningfully explained. At worst, it is a term with little precise denotation, but subject to broad interpretation by Executive Branch officials. In the case of scientific communication, the dilemma is profound. When "national security" is asserted as the basis for government control of scientific communication, it is a *raison d'état* which is difficult to challenge in either a court of law or the court of public opinion.[12] In general, Federal judges and the American people historically have shown a willingness to defer to government officials justifying an action or position with a claim of "national security."[13] But, for American science, national security con-

trols on professional communication can impede scientific achievement and progress, with consequential harm to the intellectual and economic, as well as military, security of the nation.

In any discussion of increased national security controls on scientific communication, it is crucial that the national security substantiation for government regulatory actions be detailed to prevent arbitrary use of this authority, to guard against the destructive effect of its overly broad interpretation-application, and otherwise to protect the rights and civil liberties of scientists as citizens. This might be done by defining or explaining "national security" as a policy concept within this particular policy area, or circumscribing it by specifying what may be regulated in its name, or both. With these considerations in mind, it is now opportune to turn to the two remaining operative concepts—what is to be affected by increased national security controls.

Scientific Communication

In the context of the present discussion, scientific communication may be described as the open transmittal of scientific information by one or more individuals to one or more individuals largely for professional purposes. The following characteristics may be ascribed to it. There are two elements involved—scientific information and communication. At a minimum, the former of these elements pertains to information derived by the scientific method (including mathematics) and may include, as well, knowledge of practical utilization to produce useful processes, products, or programs for public or private purposes (embracing engineering and technology applications).[14] The communication or transmittal is open, meaning it is generally accessible and does not have the private character of a personal letter or individual conversation, and may be made through a variety of media—publication, teaching, professional conference participation, and speeches or lectures. Although the individual(s) who originally produced the scientific information usually initiate its premiere communication, a variety of other persons also are involved in varying ways in the scientific communication process, perhaps as secondary reporters or interpreters of findings or as facilitators of the transmittal effort. Finally, these communications are made largely for professional purposes—independent verification, criticism, improvement, and the advancement of knowledge.

A number of difficulties are posed for the scientific communication process by the prospect of it being subject to increased national security controls. Although, as noted earlier, the precise nature of these controls remains uncertain, they remain under discussion within the Executive Branch and both the substance of scientific information and the means of communication could be the object of such new regulation. With regard to the former matter, there have been some indications that there is little desire to restrict the communication of basic scientific information. In advocating the automatic inclusion of information release terms in all Department of Defense research contracts, the January, 1982, report of the Defense Science Board Task Force on University Responsiveness to National Security Requirements also added the following important caveat: "The Depart-

ment of Defense is assiduously rejecting any control guidelines that would restrain the development and dissemination of the fruits of basic research."[15] In March, 1982, Acting Deputy Under Secretary of Defense George Millburn repeated this sentence in his prepared statement before two subcommittees of the House Committee on Science and Technology holding a joint hearing on the impact of national security considerations on science and technology.[16] In his testimony before these same two panels, Admiral Bobby Inman, then Deputy Director of the Central Intelligence Agency, said he had "never presumed that draconian [control] measures against the basic research side were either warranted or likely to occur."[17] But, of course, in some fields, such as biotechnology, little practical distinction can be made between basic and applied science. And the differences become unimportant, as the following comment indicates, when considering technology, a primary object of export control.

> It is hard to distinguish the boundary lines between basic and applied science and technology. The point is that both basic and applied science are a part of technology. Thus, basic science is an information function; and applied science is an information function with a useful purpose in mind; while technology is the development and social use of information. A great deal of technological innovation, over the years, came into being without the aid of science; and conversely, a great deal of the information uncovered by science has not found useful application but is still judged as potentially useful, or as the basis for useful understanding. Also, to the extent that basic science involves measurement or observation employing tools and devices it is dependent on previous technological innovation. Many great scientific advances resulted from this sequence, as for example from the microscope, telescope, spectroscope, etc.[18]

In his prepared remarks to a panel audience at the annual conference of the American Association for the Advancement of Science in January, 1982, Admiral Inman suggested certain fields that, in his view, warranted communication controls for reasons of protecting national security. They included "computer hardware and software, other electronic gear and techniques, lasers, crop projections, and manufacturing procedures."[19] Such a topical approach was used in preparing the Militarily Critical Technologies List, a classified compilation identifying all militarily sensitive technologies that are subject to export control.[20] Various American industrial leaders, however, have severely criticized this multi-volume corpus because an overly-broad scope has been used in its preparation, resulting in the inclusion of many questionably pertinent technologies.[21] It also has attained a character quite different from that envisioned for it in its 1979 mandate.[22]

Nonetheless, in late 1983, the Department of Defense was busily developing a related Militarily Significant Emerging Technologies Awareness List which could be used to identify certain sensitive, unclassifiable, advanced technical data thought to be in need of governmental controls regarding its dissemination.[23] The internal D.O.D. report recommending this new list suggested that it might include various technologies on the Militarily Critical Technologies List, thereby reducing the M.C.T.L.'s bulk.[24] Existing export laws are seen as a potential means for enforcing restrictions on the communication of technical data included on the new list.[25] Two recent legislative formulations might be noted in this regard. A short time ago, a provision in the Omnibus Defense Authorization Act of 1983–1984

empowered the Secretary of Defense to protect "any technical data with military or space application in the possession of, or under the control of, the Department of Defense, if such data may not be exported lawfully outside the United States without an approval, authorization, or license under the Export Administration Act of 1979 (50 *U.S.C. App.* 2401–2420) or the Arms Export Control Act (22 *U.S.C.* 2751 et. seq.)."[26] Proposed amendments to the Freedom of Information Act contain a similar proviso in the form of a new exemption to the rule of disclosure, allowing the withholding of "technical data that may not be exported lawfully outside the United States without an approval, authorization, or license under Federal export laws. . . ."[27]

Intertwined with questions about the kinds of scientific information being subjected to increased national security controls are issues concerning the extent to which the government can lawfully limit communication. Recent commentaries by James R. Ferguson are very instructive regarding this area of consideration.[28] While the free speech clause of the First Amendment prescribes a specific activity to be protected against unwarranted governmental intrusion, he notes that judicial interpretation of this provision has resulted in a distinction between "expression" and "conduct." Thus, he counsels, "the first amendment generally prohibits official restraints on the communication of ideas, but does not in any way prevent the state from restricting the acts of an individual that may cause physical harm to others."[29] Scientific information, of course, may not merely affect the mind of the listener, but provide a person or another country with a capability for committing harmful acts that could not otherwise be performed.

Ferguson notes that, in its recent decisions, the Supreme Court has adopted a heirarchical view of the First Amendment, assigning different levels of protection to different categories of speech.[30] The Court has done this with a view to the major values underlying the free speech guarantee. These, he indicates, are "the individual interest in self-expression, the social interest in the free flow of information and ideas, and the political interest in informed self-government."[31] After assessing each of these major values in terms of the extent to which a system of open scientific expression promotes each of them,[32] he concludes "that the first amendment value of scientific speech is at least equal to that of any other category of expression."[33]

Finally, Ferguson explores the analyses which the Supreme Court might apply in deciding First Amendment protection of the communication of scientific information being subjected to national security controls.[34] In determining the relevant standard of review, the Court will want to know whether or not the government has a possessory interest in the information at issue. The Court will apply a mere "reasonableness" standard to official restraints imposed on Executive Branch employees or contractors in order to protect scientific data produced by, for, or on behalf of the government.[35] A far more demanding standard of review will be applied, however, if the state is attempting to control the communication of privately produced scientific information by individuals unaffiliated with the government. Ferguson mentions two major possibilities in this regard. If the government is seeking to impose a "subsequent punishment"—e.g., criminal penalties for individuals who have disseminated restricted scientific information—it

must successfully demonstrate a "compelling" interest in regulation. If the government is seeking to prevent the publication of restricted scientific information by a "prior restraint," the Court will require a demonstration that a "grave" and "irrepairable" harm will otherwise almost surely result. Although the government is confronted with an exceedingly difficult task in either situation, Ferguson notes the Court has allowed that in some "exceptional cases," largely involving national security,[36] the state's interest in regulation may be sufficient to permit a direct infringement on constitutionally protected speech. Considering government arguments for national security controls on scientific communication in terms of the nature and magnitude of the dangers posed, he suggests, with some qualification,[37] a hierarchy of possible justifications for permitting an abridgement of First Amendment freedoms. Ranked according to the potential consequences that could result in the absence of national security controls on the dissemination of a particular type of scientific information, the categories are as follow:

1. *most serious danger*—alteration of the current balance of international military power in major ways;
2. *lesser harms*—enabling a foreign adversary to augment incrementally its current military strength through improvement of weapons systems performance, betterment of communications networks, or expanded knowledge of United States military capabilities;
3. *less immediate harm*—enabling improvement of military research and development by a foreign adversary;
4. *additional different harm*—enabling betterment of manufacturing capabilities in militarily important industries by a foreign adversary; and
5. *additional different harm*—undermining American foreign policy goals closely tied to United States security.

Ferguson also indicates that the Court would inquire into the likelihood of the alleged danger actually occurring and consider both the complexity or sophistication of the scientific information at issue as well as the ability of the potential recipient foreign power to absorb and make use of it. He adds that, if the Court agrees with the government's argument(s) for regulatory powers, it will decide if the particular restraints on speech which have been imposed are appropriate and "will invalidate the challenged restraints if it finds that a 'less restrictive alternative' could serve the asserted interest equally well."[38]

Another value in American society that is threatened by some applications of increased national security controls on scientific communication is academic freedom. Although the full range of principles embodied in this concept are neither well developed nor agreed upon and accepted,[39] its basic element is "the right of the individual faculty member to teach, carry on research, and publish without interference from the government, the community, the university administration, or his fellow faculty members."[40] A decade ago, an authoritative assessment of academic freedom in the United States noted that its defense and support had

been "relatively mild," deriving largely from one organization, and that the role of the courts in molding the concept as a distinct legal right "has been a limited one."[41] In these regards, the situation does not appear to have changed much in the intervening years. Then and today, "academic freedom," given its conceptual uncertainties, might be best defended in litigation in terms of First Amendment freedoms.[42]

Apart from the rights that individual faculty members may assert in terms of "academic freedom," the university, as a community, may seek to protect its collective liberty in the face of increased national security controls on scientific communication. Some years ago, Justice Felix Frankfurter suggested there are "four 'essential freedoms' of a university—to determine for itself on academic grounds who may teach, what may be taught, how it shall be taught, and who may be admitted to study."[43] Certainly faculty members, campus officials, and students have a considerable common interest in these academic rights.

Some types of national security controls on scientific communication challenging the freedoms of faculty and the university are already discernable. Through restrictions in research contracts, the government, to some extent, can negatively regulate what, how, and, in the case of foreign nationals, who may be taught. Similarly, contract controls can be used in some regards to regulate faculty research presentations at professional conferences and in publications, which can affect standing with colleagues and in the university. After contracted research is underway, security classification can be imposed on the project or particular findings in defiance of university prohibitions on secret studies, and principal investigators may be required to sign life-long non-disclosure agreements.

More stringently applied export control authority also could be negatively used to some extent by the government to regulate what, how, and who may be taught on the campus. Presentations of research findings by faculty at professional conferences and in journals could be similarly affected as well. And when university officials decline to monitor or police the activities of certain foreign students, scholars, or lecturers scheduled to visit their campus, the government can pressure for cooperation by threatening to withhold the necessary visa.

The inducements to accept these controls are rather obvious. Research contracts from the government are an important financial resource for universities, particularly in the currently depressed economy, and they have traditionally provided a means for professional recognition and advancement for faculty. Unacceptance of export control restrictions necessitates lengthy and expensive litigation by a university or faculty member, and may result in administrative and civil penalties and fines and the chance of being denied Federal contracts. There also is the pressure of patriotism and public opinion. Commenting on "the possibility of being 'blacklisted'," C. Peter Magrath, the president of the University of Minnesota, recently related the following experience in testimony before a congressional subcommittee.

> I know of five university presidents who received just such a warning from a private foundation. The foundation promised to sponsor adverse shareholder resolutions at corporate and philan-

throphic meetings, because it determined that resistance to intrusive regulations was itself a threat to national security.[44]

It cannot be denied that these are powerful and paramount influences. They will be difficult to withstand. Thus, in this contest of security verses freedom, the demands that they seek to sustain must be tempered before reaching the campus.

HISTORY

From the birth of the Republic until the dawn of modern global war, Federal policy largely was supportive of the tradition in scientific research of open communication, free exchange of information, and wide publication.[45] The entry of the United States into World War I, however, brought a variety of restrictions.[46] American scientists, like any other citizen publicizing information related to the war effort, were subject to censorship and prosecution for loyalty-security breaches.[47] Scientists also were prohibited from engaging in any export or "trade"—i.e. "deal with, exchange, transmit, transfer, assign, or otherwise dispose of, or receive any form of property"—with an enemy without a license from the President.[48] And scientists seeking a patent might be ordered to keep their invention secret until the end of the war, at which time the appliction would be granted, because normal publication in this regard was deemed to be "detrimental to the public safety or defense, or may assist the enemy or endanger the successful prosecution of the war."[49] In addition to these controls, the National Research Council of the National Academy of Sciences apparently played an important role in identifying, encouraging, and coordinating militarily significant scientific research, and in educating and otherwise apprising scientists of the military importance and sensitivity of their studies and findings.[50]

On the eve of American entry into World War II, various restrictions affecting the open communications of scientists were activated. In 1940, Congress broadened the Patent Commissioner's discretion to order an invention be kept secret by deleting the requirement that the United States be at war and by allowing the Commissioner to withhold the grant of a patent "for such period or periods as in his opinion the national interest requires."[51] This authority lasted until the end of the war.[52]

The First War Powers Act, signed into law eleven days after the attack on Pearl Harbor, conferred on the President the authority to censor all communications with foreign countries.[53] The domestic press and radio were controlled on a strictly voluntary and extra-legal basis under a censorship code issued by the Office of Censorship.[54] A similar such arrangement was in operation within the scientific community well before the declaration of war.

Growing concern among some scientists about the open publication of scientific information of potential military value, particularly in the area of uranium fission, prompted the National Research Council to form a special control committee in April, 1940.[55] Through the voluntary cooperation of the editors of various professional journals, the panel or one of its subcommittees reviewed manuscripts and

papers for possible vital defense information. Judgments were offered as to the advisability of publication. This review system was nominally in operation until June, 1945, but the absorption of many scientists into government-sponsored war work of one sort or another almost eliminated the flow of submissions.[36] Indeed, it appears that the government possessed considerable regulatory power over the open communication of scientific information as a consequence of its large-scale employment of scientists or sponsorship of their research during the war years.

Two other developments during this period also are noteworthy. Security classification procedures, which previously had been mandated largely through armed forces regulations and directives, attained a presidential character in 1940 when the first executive order in this policy area was issued.[37] It gave civilian employees of the government in certain agencies authority to create official secrets in order to safeguard national defense interests.

Loyalty-security practices became more formal and sophisticated during this period as well. A great many scientists were introduced to such a program when they joined the Manhattan Project. Because the operation was under the supervision of the Army Corps of Engineers, prevailing military wartime security requirements were applicable. But some special protective procedures also were utilized. Foremost among these, in the view of Project manager General Leslie R. Groves, was compartmentalization of knowledge: ". . . each man should know everything he needed to know to do his job and nothing else."[38] In addition, code names and words were used to mask certain sensitive and secret matters; both official and personal correspondence was monitored for indiscretions; "loose-talk" cases were investigated and acted upon; Project personnel were scrutinized and required to meet established loyalty and integrity requirements; a vigorous security-education program was maintained; public relations efforts were made to obtain the cooperation of newspapers and the populace of communities adjacent to Project plant sites; and a censorship-review program was created to limit media reports relating to the existence of the Manhatten Project, its activities or those of its component units, personnel, and contractors, or to atomic theory, equipment, and materials. The censorship-review program was conducted in cooperation with the Office of Censorship and, by the spring of 1944, covered 370 newspapers and 70 magazines.[39]

Personnel having access to any official secrets of the Project were subject to a background investigation to establish their loyalty, integrity, and discretion. Approved individuals were informed of the penalties for disclosing classified information improperly and "then required to read and sign either the Espionage Act or a special secrecy agreement."[40] By August, 1945, some 400,000 Manhattan District employees reportedly had been investigated and approximately 600 companies involved in the Project had been cleared. Business firms received security approvals if Army intelligence files, a Dun and Bradstreet credit report, and agency checks of key personnel resulted in no adverse findings.[41]

During World War II, the Federal Government supported and promoted a wide variety of scientific research. This experience appears not only to have convinced the nation's leaders of the value of such enterprise for the country and to have persuaded them to continue such sponsorship, but also to have awakened officials

to the possibilities and desirabilities of restricting the public availability of some research information for reasons of "national security." Indeed, with the onset of the Cold War, the term "national security" suddenly became prominent in a variety of official pronouncements, presidential directives, statutes, and agency regulations. It came to be a undefined policy justification, a *raison d'état*, a habit of mind challenging, among other freedoms, the tradition of open scientific communication.

In 1946, although many scientists remained dissatisfied with the resulting legislation after their vigorous and concerted efforts to improve it,[62] the Atomic Energy Act was signed into law.[63] This statute provided the Federal Government an absolute monopoly over all aspects of atomic energy research, development, and production. In addition, it set rigid security limitations on the dissemination of what was termed Restricted Data which broadly and generally embraced all information concerning atomic weapons and fissionable material. Although the atomic energy program was largely overhauled in 1954 to allow industrial participation in nuclear power applications,[64] the Restricted Data controls of the 1946 act were continued. Shortly after the original law was enacted, Professor Zechariah Chafee, Jr., commented: "The controversy over atomic bomb control shows how the claim of military security may possibly be used to hamper civilians in proper scientific activity, the progress of which depends on public communication in lectures and learned periodicals."[65]

In 1947, President Harry S Truman issued an executive order creating the first systematic and all-inclusive Federal personnel loyalty-security screening program.[66] In requiring a loyalty investigation for all applicants for employment and all current civil servants, the basic standard to be applied was whether, on all the evidence, "reasonable grounds exist for the belief that the person involved is disloyal to the Government of the United States," or, as modified in 1951, "reasonable doubt as to the loyalty of the person involved to the Government of the United States."[67] Among the considerations to be made in determining loyalty were "intentional, unauthorized disclosure of confidential documents or information" and performing duties or acting "so as to serve the interests of another government in preference to the interests of the United States." In the atmosphere of Cold War anxieties, few scientists in government or thinking of joining the government wished to engage in professional communications which might be questioned on these terms. In addition, caution was advisable in becoming involved in any way with organizations, associations, or movements critical of government policy or American society.[68] President Dwight D. Eisenhower issued a more comprehensive order in 1953, making agency heads responsible for "establishing and maintaining . . . an effective program to insure that the employment and retention in employment of any civilian officer or employee . . . is clearly consistent with the interests of the national security."[69] Three years later, this directive was drastically curtailed by the Supreme Court in a decision which effectively made it inapplicable to most Federal employees.[70]

Although the Federal Government traditionally had restricted exports only in times of war or special emergencies, the policy of exerting rigid peacetime restraints over United States exports to certain countries for reasons of national

security began with the Export Control Act of 1949.[71] While the purpose of the law was to require proper licensing for regulated goods to be shipped to particular foreign destinations, the authority of the statute came to be directed against scientists in an unusual way. During the early 1950s, American scientists mailing unclassified scientific information to friends and colleagues abroad were required by the Department of Commerce to affix an "Export license not required" label on the outside of envelopes to indicate they were aware of export regulations and had not violated general export license requirements. This situation resulted from a claim by the Department that the Export Control Act conveyed authority to exercise discretion over the export of technical data as well as commodities, with "technical data" being interpreted to include basic scientific research information.[72]

Two high-level studies had recently counseled against such restrictions. In its 1947 report, the President's Scientific Research Board, chaired by John R. Steelman, concluded that government security regulations "should be applied only when strictly necessary and then limited to specific instruments, machines or processes. They should not attempt to cover basic principles or fundamental knowledge."[73] A 1950 report on the role of the Department of State in the field of national and international science, prepared for the Department by Dr. Lloyd V. Berkner under the sponsorship of the National Academy of Sciences, found "ample evidence that unnecessary restrictions exist on the flow of unclassified scientific and technological information" and, among other relevant conclusions, stated: "These restrictions are dangerous to the progress of United States science, affect adversely the conduct of foreign relations in science, and are therefore damaging to our national security."[74]

The protests of scientists prompted the House Special Subcommittee on Government Information to champion a recommendation, formally endorsed by its parent committee, that the Export Control Act be amended to make it clear that "technical data" did not include scientific information of an unclassified nature.[75] Although the Department of Commerce revised its regulations to permit overseas mailings of nonclassified scientific and technical information if the material was sent first class by a person without "commercial" connections, the controversy did not subside until a more liberal policy on exports to Communist bloc countries emerged during the 1960s and the Export Administration Act of 1969,[76] reflecting this new position, was adopted.[77]

In 1951, the security classification program was completely overhauled with a sweeping new executive order.[78] In issuing the new directive, the President indicated he was relying upon very general powers conferred by the Consitution and relevant statutes. Four levels of classification were prescribed, but their use was no longer confined to traditional national defense matters. This policy shift was evident in two ways. First, information was now classified in the interest of "national security." Second, classification authority was extended to nonmilitary agencies, those which presumably had a role in "national security" policy. The order resorted to citing portions of the Espionage Act to reinforce its requirements. Classified materials furnished to authorized persons "in or out of Federal service, other than the Executive Branch," were to bear a warning statement

concerning their improper disclosure and to make reference to two sections of espionage law.

Criticism of the broad authority conveyed by the order prompted President Eisenhower to seek a review of the directive by the Attorney General for purposes of revising or rescinding it. The subsequent recommendation was for a new order which was issued in November, 1953.[79] This executive order, subsequent amendments to it, and succeeding presidential directives on security classification policy and procedure promulgated in 1971[80] and 1978[81] narrowed the bases and discretion for assigning official secrecy to agency records. All of these changes, of course, affected the classifiability of scientific information held by the government.

In 1952, a permanent statute on patent security was signed into law.[82] The Invention Secrecy Act provided that, "(w)henever the publication or disclosure of an invention by the granting of a patent, in which the Government does not have a property interest, might, in the opinion of the [Patent] Commissioner, be detrimental to the national security," he shall make the application available to certain specified defense agencies for review. In the event that one of them determined that "the publication or disclosure of the invention by the granting of a patent therefor would be detrimental to the national security, . . . the Commissioner shall order that the invention be kept secret and shall withhold the grant of a patent" for not more than one year, subject to a possible renewal.

Almost three years later, in November, 1954, Secretary of Commerce Sinclair Weeks announced that, at the direction of the President and on the recommendation of the National Security Council, he was creating an Office of Strategic Information within his department.[83] The mission of the new entity, according to the Secretary, was to work with various private sector groups "in voluntary efforts to prevent unclassified strategic data from being made available to those foreign nations which might use such data in a manner harmful to the defense interests of the United States."[84] The Office, however, was something of an anomaly. It had no legislative charter and its activities, in many regards, appeared to overlap with and duplicate certain more clearly and statutorily stated functions of other agencies. Because the concept of "strategic information" was not clearly defined, its regulatory application seemed to be of uneven, i.e. sometimes unfair, impact. Nevertheless, the Office sought to correct the imbalance favoring the Communist bloc in exchanges of scientific, technical, and economic information and to alert Federal agencies as well as scientists, businesses, and the press to the dangers of indiscriminate publication of unclassified information of possible benefit to an enemy nation.

Both the journalism and science communities brought their protests against the regulatory efforts of the Office to the attention of the House Special Subcommittee on Government Information.[85] This panel concluded that the Office served no useful purpose and urged its abolition, a recommendation endorsed by the parent Committee on Government Operations in 1956.[86] In April of the following year, the House of Representatives eliminated all funds for the Office and prohibited the transfer of money from other sources for its continuation.[87] When the Senate agreed to this action, Secretary Weeks was forced to abolish the Office.[88]

Additional "national security" constraints on scientific communication did not materialize during the latter half of the 1950s. Perhaps this was due to a change in thinking within the government and the nation in the aftermath of the confrontation and censure of Senator Joseph R. McCarthy. Perhaps it was due to the change in congressional leadership. The obsession with internal Communist subversion was subsiding. Then came Sputnik and the imperative to regain supremacy in scientific achievement. Competition gave away to various programs of scientific cooperation with the Soviet Union as relations between the two superpowers warmed in an atmosphere of peaceful co-existence. But as the 1970s passed into history, old anxieties began to mount. With the Soviet invasion of Afghanistan, the era of "detente" came to a halt and old habits of thought began to surface once again.

CURRENT CLASH

The change in attitude became apparent initially when Federal officials sought to limit certain presentations or participants at scientific professional conferences and the teaching of some scientific subject matter to certain foreign students. In general, the explanations for these restrictive actions were that some particular kind of information, sensitive in a national security context, was being improperly imparted and, in order to prevent this conveyance, the government was exercising its regulatory powers. Various incidents of this type were publicly reported. In February, 1980, the Department of Commerce informed American Vacuum Society organizers of a small international meeting on magnetic bubble memory devices that the presence of certain foreign nationals at the conference subjected the scheduled proceedings to compliance with export requirements. In order to avoid possible fines or imprisonment for failure to comply with export regulations, the sponsors of the gathering rescinded the invitations that had been sent to attendees coming from Hungary, Poland, and the Soviet Union. Scientists from the People's Republic of China, who were already en route, were permitted to attend the meeting, provided that they signed an agreement not to "reexport" what they learned to any nationals from 18 named countries.[90]

Later in the same month, the Department of State prohibited nine Soviet citizens from traveling to a conference on lasers, electro-optical systems, and inertial confinement fusion which had been jointly organized by the Institute of Electrical and Electronics Engineers and the Optical Society of America. The reasons given for the restriction reportedly were that certain sensitive technical equipment would be on open display at the gathering and also because of the official response of the United States to the invasion of Afghanistan by the U.S.S.R.[90]

In early 1981, the Department of State imposed various conditions on a Hungarian engineer's scheduled stay at Cornell University to study electronics, which resulted in the visit being cancelled.[91] Later that autumn, the Department began asking academic officials at various major universities to cooperate in prohibiting visiting students from the People's Republic of China from engaging in research and studies in certain scientific and technological areas that were regarded as

being subject to export restrictions. Many campus administrators declined to engage in such policing actions.[93]

In the spring of 1982, customs inspectors, acting under the authority of export control regulations, seized a shipment of computer science books which a professional society was shipping to Japan. Although the volumes reportedly were publicly available in the United States, customs officials indicated they were being held pending detailed explanations of their contents and destination.[93] In May, five visiting Chinese scholars about to depart on a homeward flight found their luggage had been confiscated by customs agents who scrutinized various items contained in their bags—scientific journals, classroom notebooks, thesis and lecture materials, slides, innocuous computer software, and tapes of rock music. The search reportedly was conducted as part of a new aggressive program—identified as Operation Exodus by a Commerce Department official—to check the outflow of high technology information.[94] Around this same time, nationals from Communist countries were denied on-line access to the National Library of Medicine's MEDLINE service, a computerized index of articles appearing in some 3,000 medical and biomedical journals. The action reportedly was prompted by concerns within the Department of Commerce that a skillful computer operator might jump from MEDLINE to some other sensitive file. Without on-line access, Communist nationals would have to make their MEDLINE inquiries by mail.[95]

In August, 1982, at least 100 of 700 papers listed in the program of the annual technical symposium of the Society of Photo-Optical Instrumentation Engineers were withdrawn at the last minute by their authors after the Department of Defense let it be known that some of the scheduled presentations might violate export regulations. Many of these authors reportedly were under contract to or were employees of the Defense Department, and there was considerable confusion as to whether or not their papers had been properly cleared by D.O.D. officials. As a consequence of this dramatic incident, some members of the Society withdrew from the organization because they believed it had incurred the animosity of Defense officials, some who presented papers without any difficulties later asked that they not be published in the conference proceedings, and some participants sought refunds of their registration fees.[96]

In addition to these restrictive actions, arguments or proposals for increased national security controls on scientific communication have been advanced from various quarters, and some new regulatory policies have been established. In April, 1981, the Public Cryptography Study Group, formed the previous year by the American Council on Education with funding from the National Science Foundation, issued a report recommending that the National Security Agency conduct, on a trial basis, voluntary, prepublication review of manuscripts on cryptography.[97] However, one of the panel's nine members vigorously dissented from the position taken by his colleagues[98] and, a short time later, an N.S.F. advisory committee counseling the Foundation about support of cryptological research took specific exception to the Study Group's recommendation.[99] Although others involved in cryptographic research and explorations also expressed criticism of and skepticism about the pre-publication review proposal, the Director of N.S.A. proceeded to implement it and urged scholars and publishers to cooperate.[100]

It was also in 1981 that the Department of Defense published *Soviet Military Power*, "a distillation of briefings provided to the NATO Ministers of Defense" describing "the totality of the Soviet military buildup."[101] A chapter on the Soviet quest for technological superiority offered the following comment in a section concerning technology transfer.

> In addition to the acquisition of Western industrial plants and equipment, the decade of the 1970s has also witnessed greatly expanded contact between the Free World and Soviet scientists and engineers. The scope and depth of their interest in the advanced and emerging technologies is exemplified by the exchange agreements that the Soviet Union has negotiated with the United States since 1972.[102]

Similarly, student and scholar exchanges, interchanges between members of the United States and Soviet Academies of Science, American scientific conferences and symposia, the availability of research reports from the National Technical Information Service, and open professional literature in the United States also were cited in this regard. The section then concluded with the following comment: "The Soviets are seeking Western technology and equipment by any and all means in their quest for technological superiority."[103]

In October, 1981, William D. Carey, executive officer of the American Association for the Advancement of Science, wrote to Deputy Secretary of Defense Frank Carlucci, saying he was "dismayed to find the Defense Department indicting inter-Academy exchanges, student exchanges, scientific conferences and symposia, and the entire 'professional and open literature' as inherently adverse to U.S. military security interests." He concluded by indicating he was "exercised by the position taken by the Defense Department in *Soviet Military Power*. . . ."

> In particular, that position strikes in a deadly way at the dependence of scientific progress on open communication and shared information. Our own military power will be diminished, not enhanced, if the wellheads of scientific communication are sealed and new knowledge confined in silos of secrecy and prior restraint.

In his reply, Deputy Secretary Carlucci wrote "the DOD is well aware of how scientific practice is conducted and fully recognizes the importance of unimpaired scientific communications to the mutual benefit of all parties concerned." He then indicated it was the Department's view that scientific exchanges with the Soviet Union had not been reciprocal and said "it is quite apparent the Soviets exploit scientific exchanges as well as a variety of other means in a highly orchestrated, centrally directed effort aimed at gathering the technical information required to enhance their military posture." He provided various examples which, in his opinion, "indicate the basis of our concern," and concluded with the following words:

> By the very nature of our open and free society, we recognize that we will never be able to halt fully the flow of militarily critical technology to the Soviet Union. Nevertheless, we believe that it is possible to inhibit this flow without infringing upon legitimate scientific discourse.[104]

On December 18, 1981, Attorney General William French Smith, speaking before the World Affairs Council in Los Angeles, delivered a major policy address

on attempts to counter Soviet espionage in the United States. In the course of his remarks, the Attorney General stated that "hostile intelligence services have placed a high priority on scientific and technical information, much of which is unclassified proprietary data." A growing number of foreign intelligence agents, operating within the country under a variety of guises, "befriend employees in the United States, request innocuous information on various pretexts with nominal reimbursement, and finally attempt to obtain sensitive information in return for substantial cash payments." American businessmen "traveling in the Soviet bloc are lured into compromising situations and then blackmailed into providing information and services." High technology items "that cannot legally be exported to the Soviet bloc are frequently sent to 'front' corporations in Western Europe and then transshipped to the ultimate destination." The Attorney General assured his audience that "the Justice Department is committed to vigorous enforcement of national security legislation, including laws prohibiting unlawful export of advanced technology and munitions."[105]

In early January, 1982, C.I.A. Deputy Director Bobby R. Inman, speaking as a panelist at the annual meeting of the American Association for the Advancement of Science, suggested that "A potential balance between national security and science may lie in an arrangement to include in the peer review process (prior to the start of research and prior to publication) the question of potential harm to the nation." As Director of the National Security Agency, Admiral Inman had prompted the American Council on Education to form the Public Cryptography Study Group which recommended a voluntary system for prepublication review of manuscripts on cryptography. He seemed to be advocating the creation of a similar review arrangement, embracing not only prepublication review, but also the initiation of research as well, for various areas of scientific study. Examples which he suggested included computer hardware and software, electronic gear and techniques, lasers, crop projections, and manufacturing processes. If scientists did not cooperate in keeping certain of their research information safeguarded voluntarily, Inman warned the A.A.A.S. audience, public outrage over the resulting "hemorrhage of the country's technology" would result in law restricting the publication of scientific work that the government considered "sensitive" on national security grounds.[106]

That same month the Defense Science Board Task Force on University Responsiveness to National Security Requirements issued its report finding, among other conclusions, that "Certain specific areas of university research, especially those conducted under DoD contract, are sensitive from an export control point-of-view."[107] The report also made the following charge: "Numerous advances in Soviet military weapon systems are directly traceable to technology transfers that occurred as a result of Soviet and Warsaw Pact student and scientist exchanges and their attendance at international scientific symposia held in the United States."[108] Accordingly, interpretation of export control regulations for university researchers "is required" and consistent guidelines limiting distribution of certain sensitive, unclassified scientific information was recommended.[109] These controls would be written into all research contracts funded by the Department of Defense, some of those funded by other Federal departments, and would provide guidance

in certain privately funded research contracts.[110] Guidelines would be formulated "with the help of the universities"[111] and would not be "overly restrictive" or "inhibit the legitimate flow of scientific information."[112]

In late January, *Newsweek* reported that the Department of Commerce was planning to propose legislation "making it a felony for researchers to disclose sensitive data in any form—including publications, meetings or classrooms—without first obtaining a license."[113] No additional details regarding this proposal were given.

In March, President Ronald Reagan provided some direct indication of his views about the possibilities of limiting future scientific cooperation and information exchanges with the communist bloc. In his first annual message to Congress on the United States Government's international activities in the field of science and technology, he expressed a generally positive outlook on future cooperation with the nations of Western Europe, Canada, Japan, and other industrialized democracies. He then specifically criticized the Soviet Union for making many of its best scientists and scientific institutions offlimits to foreigners, for severely punishing those who disclose nonsensitive unpublished research results, for restricting the travel of their own scientists to conferences abroad and closing their own scientific meetings to Westerners, for limiting the careers of Jewish scientists, and for mistreating scientists who express opinions contrary to official doctrine or who wish to emigrate. He noted that, in addition to the 11 bilateral technical agreements that his predecessor had cancelled after the Soviet invasion of Afghanistan, he intended to cancel three other bilateral scientific and technical agreements with the U.S.S.R., and he had "requested a complete review of all other exchanges with the Soviet Union." In conclusion, the President's message said: "Future cooperation with the Soviet Union depends on the steps they take to comply with recognized norms of peaceful intercourse among nations."[114]

Later that month, President Reagan informed the Chancellor of Austria that he opposed further United States funding for the International Institute for Applied Systems Analysis. Created in 1972 and located in the outskirts of Vienna, the Institute was established to explore problems common to industrialized nations. Its funding and participants come from both N.A.T.O. and Warsaw Pact countries. Among the reasons expressed for discontinuing United States support of and involvement in the Institute was a concern about Soviet and Eastern European researchers, some of whom were not thought to be "bona fide" scientists, having access to Western data bases through I.I.A.S.A. computers.[115] Funds for United States membership in the Institute were subsequently provided by the American Academy of Arts and Sciences.

In April, the President issued E.O. 12356, a directive prescribing new security classification criteria and procedures.[116] Both the content of the order and the closed manner in which it was developed had prompted congressional reproof during the previous two months.[117] When a House subcommittee invited the Administration to send representatives to a hearing on the draft directive, the offer was refused.[118] A subsequent report based on these proceedings criticized the order in a variety of ways.[119] In brief, although three Presidents during the past 30 years promulgated security classification executive orders successively nar-

rowing the bases and discretion for assigning official secrecy to Executive Branch information and materials, E.O. 12356 not only ignored this trend, but also reversed it.[120]

The policy and practice established by the new directive certainly had implications for science. Missing was a provision which had appeared in the predecessor order proscribing the classification of a "product of nongovernment research and development that does not incorporate or reveal classified information to which the producer or developer was given prior access . . . until and unless the government acquires a property interest in the product."[121] E.O. 12356 introduced two new classification categories applicable to scientific information—one concerning "the vulnerabilities or capabilities of systems, installations, projects, or plans relating to the national security," and the other pertaining to "cryptology." In addition, the order explicitly warned "contractors, licensees, and grantees" that they would be subject to appropriate sanctions for improperly handling classified information. In general, by expanding the categories of classification, mandating that information falling within these categories be classified, making reclassification authority available, admonishing classifiers to err on the side of classification, and eliminating automatic declassification arrangements, the new directive seemed to suggest more classification, less declassification, and the longer duration of official secrecy for government records and materials, including scientific research documents and papers produced by or for the Federal departments and agencies.

It was also in April that the intelligence community publicly released *Soviet Acquisition of Western Technology*, a report describing "the Soviet program to acquire U.S. and Western technology, the acquisition mechanisms used, the spectrum of Western acquisitions that have contributed to Soviet military might, the projected Soviet priority needs for Western technology, and the problems of effectively stemming the transfer of Western technology that could someday find application in weapons used to threaten the West."[122] The general thrust of this document is conveyed by the following comment:

> The Soviets and their Warsaw Pact allies have obtained vast amounts of militarily significant Western technology and equipment through legal and illegal means. They have succeeded in acquiring the most advanced Western technology by using, in part, their scientific and technological agreements with the West to facilitate access to the new technologies that are emerging from the Free World's applied scientific research efforts; by spending their scarce hard currency to illegally purchase controlled equipment, as well as to legally purchase uncontrolled advanced Western technologies having military-industrial applications; and by tasking their intelligence services to acquire illegally those US and Western technologies that are classified and export controlled.[123]

In September, the Department of Defense reportedly was considering establishing a committee to screen scientific papers deriving from Defense-sponsored research prior to their presentation at professional conferences or publication. Proponents hoped such a panel might avert last-minute restriction of numerous presentations, as had recently occurred at a Society of Photo-Optical Instrumentation Engineers' conference. It was not clear, however, how many meetings and

papers were being contemplated for committee scrutiny, how long the review process would take, what criteria would be used in the evaluation, or what recourse would be available in the event of a censorship ruling.[124]

On December 23, 1982, President Reagan issued National Security Study Directive 14–92 establishing a temporary interagency group, chaired by the Office of Science and Technology Policy, which was mandated to "review the issue of protecting sensitive, but unclassified scientific research information, taking into account the recommendations made by the National Academy of Sciences' Panel on Scientific Communication and National Security." The National Academy study body had released a report on September 30 which, while acknowledging there has been a "substantial transfer" of American technology to the Soviet Union, concluded "that universities and open scientific communication have been the source of very little of this technology transfer problem."[125] The object of the review to be conducted by the temporary interagency group was to produce a report for the National Security Council no later than March 1, 1983. This report was to be used by the Council to prepare a National Security Decision Directive on the protection of sensitive, but unclassified scientific information.[126] In February, the interagency group's effort was made part of a broader White House study of export controls and its report deadline was extended to the late fall.[127] By June, some scientists reportedly had fears that the group's conclusions and recommendations, and the related N.S.D.D., would be classified, precluding public scrutiny of or comment upon the directive.[128] By the end of the year, however, the interagency group appeared to be moribund and there was doubt that the Administration would give any formal consideration to the National Academy report.

On March 11, 1983, the Reagan Administration released N.S.D.D. 84 which set forth essentially four policy points. First, all present and future employees of the Executive Branch with authorized access to classified information would be required to sign a lifetime nondisclosure agreement as a condition of having access to such information. Second, all present and future employees of the Executive Branch with authorized access to Sensitive Compartmented Information, a kind of intelligence information, would be required to sign a lifetime nondisclosure agreement as a condition of having access to S.C.I. and other classified information, and this particular agreement would include a provision for prepublication review of manuscripts and drafts of public statements, speeches, or lectures to assure deletion of S.C.I. and other classified information. Third, appropriate arrangements would be established governing contacts between media representatives and agency personnel, "so as to reduce the opportunity for negligent or deliberate disclosures of classified information." Fourth, Executive Branch employees might be required to submit to polygraph examinations, when appropriate, in the course of investigations of unauthorized disclosures of classified information, including S.C.I. Secrecy agreements have been utilized for some time within the Federal intelligence agencies and, in 1980, were found by the Supreme Court to be a proper enforcement device to prevent unauthorized disclosure of classified information.[129] N.S.D.D. 84 extended the use of such contracts to all Executive Branch personnel having access to classified materials. The Director

of the Information Security Oversight Office has confirmed that, where deemed appropriate by officials, the requirements of N.S.D.D. 84 can be applied to government contractors.[130] In the fall of 1983, however, Congress attached amendments to two authorization bills to prohibit temporarily the implementation of the directive's polygraph examination[131] and nondisclosure contract provisions.[132]

In mid-April, the Department of Defense-University Forum developed a working draft statement on controls to delay the transfer of sensitive technology in campus settings. The creation of the D.O.D.-University Forum had been proposed by a Defense Science Board task force in January, 1982.[133] Quickly formed and made operative by the following month, the group consisted of eight university presidents, the heads of three education organizations, and nine members representing Defense Department entities. The April, 1983, working draft suggested that D.O.D. establish a technology committee to identify unclassified but sensitive fields of research. Federal contract and grant applicants would then be apprised when their projects were within these sensitive areas and special conditions, such as barring participation by certain foreign nationals, would attach to these awards. A 60–day prepublication review of papers on sensitive subjects also was urged, but the ultimate responsibility for publication in these cases would lie with the university or principal investigator.[134]

In the final months of 1983, there were three major developments regarding national security controls on scientific communication. As noted earlier, a provision was appended to the Department of Defense Authorization Act for 1984, giving the Secretary of Defense authority to "withhold from public disclosure any technical data with military or space application in the possession of, or under the control of, the Department of Defense, if such data may not be exported lawfully outside the United States without an approval, authorization, or license under the Export Administration Act . . . or the Arms Export Control Act."[135] The President signed the measure of September 24, 1983, and by mid-November, the Department of Defense had draft regulations prepared for implementing the technical data control provision.

In late September, the House began debate on and refinement of legislation to revise and extend the Export Administration Act.[136] Both congressional chambers moved quickly to advance the automatic expiration date of the statute by two weeks.[137] It was scheduled to lapse at the end of the month, but this was averted.[138] In early October, the House again approved a two-week advancement of the expiration deadline,[139] but the Senate failed to adopt this legislation before leaving on a holiday recess. Although the Export Administration Act expired on October 14, President Reagan invoked national emergency powers to continue export regulatory authority.[140] On October 27, the House completed action on legislation revising the Act.[141] The resulting bill does not appear to authorize broad new national security controls on scientific communication.[142] In October and November, the House also sought to revive the lapsed export statute by adjusting its expiration date.[143] The Senate, however, took no action on any legislation revising the Export Administration Act before the first session of the 98th Contress concluded on November 18.

Finally, it was revealed in October that officials in the Department of Defense were considering an elaborate new system to restrict the availability of a new category of unclassified sensitive technical information which would be identified in a Militarily Significant Emerging Technologies Awareness List or M.E.T.A.L. Protection would be effectuated through the use of export controls, new D.O.D. authority to prohibit the public disclosure of certain technical data,[144] and contract restraints. In addition, proponents of the M.E.T.A.L. system reportedly have urged that the Defense Department strengthen its restriction capability in this area by seeking exemptions to the Freedom of Information Act for certain technical information produced by some other departments and agencies, obtaining a proprietary interest in emerging technologies of potential military value through grants and contracts, and making contractors and grantees legally and materially responsible for the proper protection of sensitive scientific information and technical data by inserting such requirements in their award agreements. And some thought apparently has been given to making new use of existing export control law to limit the availability of sensitive technical information to private publications specializing in defense research and production project reporting. It is anticipated that most of these restrictions could be accomplished by modifying departmental regulations, rather than statutory amendments.[145]

SEEKING RESOLVE

The integrity of science will not be enhanced by increased national security controls on scientific communication. International conditions, foreign policy, and national defense considerations argue that there must be some government regulation of the disclosure and dissemination of some kinds of scientific information and technological data. On various occasions during the past forty years, the consensus of opinion on the nature and extent of this control has resulted in different succeeding export statutes. Changes in existing export control policy must be sustained by a new consensus. However, in many regards, the current proponents of increased national security controls on scientific communication have not evidenced a willingness to submit to a consensus process. Dr. Harold D. Lasswell stated the case very well in the following succinct comment:

> Since all security policies entail risk, the public interest calls for the calculation of risk by a *procedure* that balances each policy against every policy and arrives at a judgment to which many minds have contributed. Only by developing proper procedures can public confidence be gained or vindicated in the long-run wisdom of the outcome. At any given moment well-informed persons may disagree as to whether defense expenditures are too high or too low, or whether the over-all defense program is in balance or seriously unbalanced. The public must estimate the bias and competence of rival leaders. The public interest can be protected by the use of a procedure that takes conflicting views into account and subjects them to the discipline of debate and exposure to available knowledge.[146]

During the course of considering increased government authority to regulate scientific communication, the purposes of the controls should be made clear. In the context of the present discussion, to establish restrictions to be used for rea-

sons of "national security" as such, without further definition or explanation, can be dangerously self-defeating. As noted earlier, if such controls are applied with a narrow perception of national security—e.g., restraining Soviet military capability—they can also impede U.S. scientific achievement and progress, with consequential harm to the intellectual, and economic, as well as military security of the nation.

It also should be clear what these controls are regulating, i.e., that their application is confined to specific technologies. The Senate Permanent Subcommittee on Investigations addressed this point in a report on technology transfer over a year ago: "Through improved intelligence, the government must determine what it is that the Soviets want and then model its response accordingly."[147]

Finally, scientists and policymakers must be aware, in terms of implications and impacts, of how national security controls regulate scientific communication. For example, with our longstanding tradition of presumptively open professional communication in science, the burden of proof should be on the government to justify both its claims for increased national security controls and its exercise of such restraints against scientific communication. The Executive Branch should refrain from and, if necessary, be prevented from establishing increased national security controls on scientific communication through new regulations creating policy not clearly and directly sanctioned by Congress in statutory law. Every effort should be made to avoid the establishment and use of secret authority, such as classified National Security Decision Directives, to effect increased national security controls on scientific communication. Scientists and university officials must exercise caution when accepting government research contracts and grants, making certain that all communications restraints are clear,[148] that they are acceptable to them,[149] and that the possibilities for subsequent national security controls being imposed during the course of a project are explained.[150]

In the end, what this controversy poses is not merely a limitation on scientific communication, but a curtailment of freedom. It is, therefore, a matter of no small consequence. The new year reminds us of the freedom exercised by the citizenry to decide such issues. And it is also a year of poignant symbolism. Indeed, a warning sounded by George Orwell in *1984* is that security may come at a substantial cost in freedom. But just as his warning is not new, the larger issue at hand also is not new. Almost two centuries ago, James Madison, in a letter to his friend Thomas Jefferson, wrote: "Perhaps it is a universal truth that the loss of liberty at home is to be charged to provisions against danger, real or pretended, from abroad."[151] Today, as then, the question remains: shall freedom endure?

NOTES AND REFERENCES

1. U. S. Congress. House. Committee on Government Operations. *Availability of Information From Federal Executive Agencies*. Hearings, 84th Congress, 2d Session (Washington: GPO, 1956), p. 756.
2. Vannevar Bush, *Science—The Endless Frontier* (Washington: National Science Foundation, 1980 [originally published 1945]), p. 29.

3. U. S. Congress. House. Committee on Government Operations. *Availability of Information From Federal Executive Agencies*. Hearings, 84th Congress, 2d Session (Washington: GPO, 1956), p. 751.
4. Since 1947, there have been created through the National Security Council different series of presidential policy instruments in which, with very rare exception, every document was highly classified. During the Carter Administration, for example, there were the Presidential Review Memorandum (PRM) and Presidential Directive (PD) series; the Reagan Administration replaced these with the National Security Study Directive and National Security Decision Directive series.
5. See 5 *U.S.C.* 553.
6. See 44 *U.S.C.* 1505(a).
7. Regarding such a requirement, however, see U. S. Congress. House. Committee on Government Operations. *Security Classification Policy and Executive Order 12356*. H. Rept. 97–731, 97th Congress, 2d Session (Washington: GPO, 1982), pp. 34–35.
8. Perhaps the most sweeping and infamous executive order ever directed against private citizens was E.O. 9066, issued in February, 1942, providing for the exclusion and incarceration of Japanese-Americans in detention camps.
9. Sidney W. Souers, "Policy Formulation for National Security," *American Political Science Review* 43 (June, 1949):535.
10. See, however, *Congressional Record* 129 (September 29, 1983):H7716–H7717.
11. See U. S. Congress. Senate. Committee on Governmental Affairs. *Emergency Powers of the District of Columbia*. Hearings, 96th Congress, 2d Session (Washington: GPO, 1980), pp. 18–19.
12. See, generally, Friedrich Meinecke, *Machiavellism* (New York: Praeger, 1965).
13. For example, to date, the government has not been forced by a court, pursuant to the Freedom of Information Act, to disclose records which were withheld for reasons of national security. It might be noted, as well, that a majority of the Supreme Court agreed in the Pentagon Papers case that a prior restraint might be possible on a government showing by clear and convincing evidence that publication would immediately and inevitably cause grave harm to national security. *New York Times Company* v. *United States*, 403 *U.S.* 726–727, 730 (1971). Also see *United States* v. *The Progressive*, 467 *F. Supp.* 990 (W.D. Wis. 1979).
14. See U. S. Congress. House. Committee on Science and Technology. *Science Policy: A Working Glossary*. Fourth edition—1978. Committee Print, 95th Congress, 2d session (Washington: GPO, 1978), pp. 21, 77–78, 82, 99–100.
15. U. S. Department of Defense. Office of the Under Secretary of Defense for Research and Engineering. *Report of the Defense Science Board Task Force on University Responsiveness to National Security Requirements* (Washington, D. C., January, 1982), p. 4–4.
16. See U. S. Congress. House. Committee on Science and Technology. *Impact of National Security Considerations on Science and Technology*. Hearing, 97th Congress, 2d Session (Washington: GPO, 1982), p. 28.
17. Ibid., p. 49.
18. U. S. Congress. House. Committee on Science and Technology. *Science Policy: A Working Glossary*. Fourth edition—1978. Committee Print, 95th Congress, 2d Session (Washington: GPO, 1978), pp. 99–100.
19. See U. S. Congress. House. Committee on Science and Technology. *Impact of National Security Considerations on Science and Technology*. Hearing, 97th Congress, 2d Session (Washington: GPO, 1982), p. 234.
20. See 50 *U.S.C. App.* 2404(d); the table of contents for the initial list of militarily critical technologies, developed by the Department of Defense pursuant to the Export Administration Act of 1979, appears in *Federal Register* 45 (October 1, 1980):65014–65019; the Department of Energy, in support of the Department of Defense, also has prepared a list of energy related militarily critical technologies which appears in Ibid., pp. 65152–65167.
21. For example, at a recent round table discussion of the management of the flow of technical information to overseas destinations, the vice chairman of Control Data Corporation described the Militarily Critical Technologies List as "an exercise in futility," said its "prime result . . .

is a loss of business by U.S. companies seeking to engage in free trade," and concluded that "in an effort to protect our truly advanced technology the MCTL should be revised and it should be shortened instead of broadened," IEEE Spectrum Magazine, "Managing The Flow of Technical Information: An Industry/Government Dialogue," Piscataway, IEEE Service Center, 1982, pp. 10–11.

22. The legislative history underlying the Militarily Critical Technologies List (see 93 *Stat.* 503, 506–508) indicates a limited list was contemplated, that it was to be an integral part of the Commodity Control List, and gives no support to it being a secret compilation. See U. S. Congress. House. Committee on Foreign Affairs. *Export Administration Act Amendments of 1979*. H. Rept. 96–200, 96th Congress, 1st Session (Washington: GPO, 1979), pp. 8–9, 16–17. On the authority of the House report regarding this matter, see U. S. Congress. House. Committee of Conference. *Export Administration Act of 1979*. H. Rept. 96–482, 96th Congress, 1st Session (Washington: GPO, 1979), p. 45.
23. See Richard Barnard, "Pentagon Weighs New Strictures On Unclassified Papers," *Defense Week* 4 (October 24, 1983):1, 10–11.
24. See Richard Barnard, "Pentagon Mulls New Technology Secrets List," *Defense Week* 4 (October 17, 1983):1, 5.
25. Richard Barnard, "Pentagon Weighs New Strictures on Unclassified Papers," *Defense Week* 4 (October 24, 1983):1.
26. 97 *Stat.* 614, 690–691.
27. S. 774, 98th Congress, 1st Session; see U. S. Congress. Senate. Committee on the Judiciary. *Freedom of Information Reform Act*. S. Rept. 98–221, 98th Congress, 1st Session (Washington: GPO, 1983), p. 26.
28. See James R. Ferguson, "Scientific and Technological Expression: A Problem in First Amendment Theory," *Harvard Civil Rights-Civil Liberties Law Review* 16 (Fall 1981):519–560; James R. Ferguson, "Scientific Freedom, National Security, and the First Amendment," *Science* 221 (August 12, 1983):620–624; James R. Ferguson, "Scientific Inquiry and the First Amendment," *Cornell Law Review* 64 (April, 1979):639–665.

    Of related interest, see Christine Alexander, "Preserving High Technology Secrets: National Security Controls on University Research and Teaching," *Law and Policy in International Business* 15, No. 1 (1983):173–240; David Favre and Matthew McKinnon, "The New Prometheus: Will Scientific Inquiry Be Bound By the Chains of Government Regulation?," *Duquesne Law Review* 19 (Summer, 1981):631–730; Kenneth Kolivoda, "The Export Administration Act's Technical Data Regulations: Do They Violate the First Amendment?," *Georgia Journal of International and Comparative Law* 11 (Fall, 1981):361–387.
29. James R. Ferguson, "Scientific and Technological Expression: A Problem in First Amendment Theory," *Harvard Civil Rights-Civil Liberties Law Review* 16 (Fall, 1981):524 (hereafter cited as Ferguson-*HCRCLLR*).
30. Ferguson-*HCRCLLR*, p. 521; James R. Ferguson, "Scientific Freedom, National Security, and the First Amendment," *Science* 221 (August 12, 1983):621 (hereafter cited as Ferguson-*Science*).
31. Ferguson-*HCRCLLR*, p. 533; Ferguson-*Science*, p. 621.
32. See Ferguson-*HCRCLLR*, pp. 533–543.
33. Ibid., p. 543.
34. See Ibid., pp. 547–558; Ferguson-*Science*, pp. 621–623.
35. See, for example, *Snepp* v. *United States*, 444 *U.S.* 507 (1980).
36. See, for example, *New York Times Company* v. *United States*, 403 *U.S.* 713, 726–727, 730.
37. Ferguson states: "This effort applies, however, only to those cases in which the government has first demonstrated two important points: (i) that the information at issue is indeed subject to the asserted dangerous use and (ii) that the information is not currently available to the receiving nation from another source." Ferguson-*Science*, p. 622.
38. Ferguson-*Science*, p. 623.
39. Thomas I. Emerson. *The System of Freedom of Expression* (New York: Random House, 1970), p. 595.
40. Ibid., p. 594.

41. Ibid., p. 597; also, generally, see Richard Hofstadter and Walter P. Metzger, *The Development of Academic Freedom in the United States* (New York: Columbia University Press), 1955.
42. See Emerson, *op. cit.*, pp. 596–626.
43. *Sweezy* v. *New Hampshire*, 354 *U.S.* 234, 255 (1957).
44. Prepared statement of C. Peter Magrath, President of the University of Minnesota, before the House Subcommittee on Courts, Civil Liberties and the Administration of Justice, Washington, D. C. November 3, 1983, p. 5.
45. See A. Hunter Dupree, *Science in the Federal Government* (Cambridge: Harvard University Press, 1957), pp. 372–373.
46. See, generally, Paul L. Murphy, *World War I and the Origin of Civil Liberties in the United States* (New York: W. W. Norton, 1979).
47. A combination of Federal statutes and executive orders sharply limited freedom of expression during the period of American involvement in the world war. The most formidable of these authorities were the Espionage Act (40 *Stat.* 217), the Trading With the Enemy Act (40 *Stat.* 411), and the Sedition Act (40 *Stat.* 553).
48. See 40 *Stat.* 411.
49. See 40 *Stat.* 394; 40 *Stat.* 411, 422.
50. See William Franklin Willoughby, *Government Organization in War Time and After* (New York: D. Appleton, 1919), pp. 22–30.
51. 54 *Stat.* 716.
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53. See 55 *Stat.* 838.
54. See U. S. Office of Censorship, *A Report on the Office of Censorship* (Washington: GPO, 1945); also see Robert E. Summers (comp.), *Wartime Censorship of Press and Radio* (New York, H. H. Wilson Company, 1942).
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59. Brown and MacDonald, *op. cit.*, p. 204.
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68. See, generally, Ralph S. Brown, Jr, *Loyalty and Security* (New Haven: Yale University Press, 1958); Walter Gellhorn, *Security, Loyalty, and Science* (Ithaca: Cornell University Press, 1950); Harold M. Hyman, *To Try Men's Souls: Loyalty Tests in American History* (Berkeley: University of California Press, 1959).
69. See E.O. 10450.
70. *Cole* v. *Young*, 351 *U.S.* 536 (1956).
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72. See U. S. Congress. House. Committee on Government Operations. *The Government's Classification of Private Ideas*. H. Rept. 96–1540, 96th Congress, 2d Session (Washington: GPO, 1980), pp. 98–99.
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74. See U. S. Department of State. International Science Policy Survey Group. *Science and Foreign Relations*. Washington, D. C., May 1950, p. 85.
75. See U. S. Congress. House. Committee on Government Operations. *Availability of Information From Federal Departments and Agencies*. H. Rept. 2947, 84th Congress, 2d Session (Washington: GPO, 1956), p. 92; also see U. S. Congress. House. Committee on Government Operations. *Availability of Information from Federal Departments and Agencies*. H. Rept. 2578, 85th Congress, 2d Session (Washington: GPO, 1958), pp. 17–28.
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98. See "The Case Against Restraints on Nongovernmental Research in Cryptography: A Minority Report by Professor George I. Davida," *Academe* 67 (December 1981):379–382.
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100. See *Federal Register* 47 (March 1, 1982):8704.
101. U. S. Department of Defense. *Soviet Military Power*. Washington, D. C., 1981, p. 5.
102. Ibid., p. 80.
103. See Ibid., pp. 80–81.
104. For the full text of both letters, see *Science* 215 (January 8, 1982):139–141.
105. For excerpts from the prepared text of the Attorney General's speech, see New York *Times*, December 19, 1981, p. 32.
106. For a slightly modified version of Admiral Inman's remarks and a rejoinder, see *Aviation Week & Space Technology* 116 (February 8, 1982):10–11, 82.
107. U. S. Department of Defense. Office of the Under Secretary of Defense for Research and Engineering. *Report of the Defense Science Board Task Force on University Responsiveness to National Security Requirements*. Washington, D. C., January 1982, p. 5–4 (note original pagination: in these double figures, the first number refers to the chapter in which the page appears while the second number pertains to the sequential position of a page within a chapter).
108. Ibid., pp. 4–6—4–7.
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116. See *Federal Register* 47 (April 6, 1982):14874–14884; also see Ibid. (April 12, 1982):15557; Ibid. (May 11, 1982):20101–20106; Ibid. (June 25, 1982):27836–27842.
117. See H. Rept. 97–731, op. cit., pp. 27–33.
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124. See Philip J. Hilts, "Pentagon Eyes Group to Screen Scientific Papers for Sensitivity," Washington *Post*, September 23, 1982, p. A19.
125. National Academy of Sciences. Panel on Scientific Communication and National Security. *Scientific Communication and National Security* (Washington: National Academy Press, 1982), p. 1.

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128. See I. Peterson, "Task Force on Science Communication and Secrecy Gets Rolling," *Science News*, 123 (June 4, 1983):357.
129. See note 35 *supra*.
130. Telephone interview by the author, December 12, 1983.
131. See 97 *Stat.* 614, 690–691.
132. See P.L. 98–164 (section 1010).
133. U. S. Department of Defense. Office of the Under Secretary of Defense for Research and Engineering. *Report of the Defense Science Board Task Force on University Responsiveness to National Security Requirements*. Washington, D. C., January 1982, p. 6–2.
134. "Controls to Delay the Transfer of 'Sensitive' Technology in University Settings." Draft by Working Group on Export Controls of the Department of Defense-University Forum. April 12, 1983. 11 p.; also see "Security Plan Proposed," *Science & Government Report* 13 (May 1, 1983):4, 5.
135. See 97 *Stat.* 614, 690–691.
136. See *Congressional Record*, 129 (September 22, 1983):H7333–H7339; Ibid. (September 26, 1983):H7450–H7466.
137. See Ibid. (September 26, 1983):H7449–H7450; Ibid. (September 27, 1983):H7485–H7486; Ibid. (September 30, 1983):S13435.
138. See 97 *Stat.* 744.
139. See *Congressional Record* 129 (October 4, 1983):H7895–H7896.
140. See E.O. 12444 in *Federal Register* 48 (October 16, 1983):48215–48216.
141. See *Congressional Record* 129 (October 27, 1983):H8738–H8766.
142. Moreover, a provision has been added to the legislation amending the Export Administration Act, indicating that the traditional scientific communication activities of universities and the academic community, such as publication, teaching, and open exchanges at professional conferences and symposia, should be free from restrictions unless security classification, government contract controls, or proprietary or trade secret limitations apply. See U. S. Congress. House. Committee on Foreign Affairs. *Export Administration Amendments Act of 1983*. H. Rept. 98-257 Part 1, 98th Congress, 1st Session (Washington: GPO, 1983), pp. 15–16, 37–38. The same language has been appended to the counterpart Senate bill as well. See U. S. Congress. Senate. Committee on Banking, Housing, and Urban Affairs. *The Export Administration Act Amendments of 1983*. S. Rept. 98-170, 98th Congress, 1st Session (Washington: GPO, 1983), pp. 3, 38.
143. See *Congressional Record* 129 (October 27, 1983):H8767; Ibid. (November 17, 1983):H10324–H10326; Ibid. (November 18, 1983):H10562–H10563, S16870–S16871; 97 *Stat.* 1391.
144. See 97 *Stat.* 614, 690–691.
145. See Richard Barnard, "Pentagon Mulls New Technology Secrets List," *Defense Week* 4 (October 17, 1983):1, 5; Richard Barnard, "Pentagon Weighs New Strictures on Unclassified Papers," *Defense Week* 4 (October 24, 1983):1, 10–11.
146. Harold D. Lasswell. *National Security and Individual Freedom* (New York, McGraw-Hill, 1950), p. 56.
147. U. S. Congress. Senate. Committee on Governmental Affairs. Permanent Subcommittee on Investigations. *Transfer of United States High Technology to the Soviet Union and Soviet Bloc Nations*. S. Rept. 97-664, 97th Congress, 2d Session (Washington: GPO, 1982), p. 68.
148. See, for example, 97 *Stat.* 614, 690–691.
149. This is a matter of mutual interest and common protection for faculty and university administrators.
150. For example, it would be important to know if security classification could be imposed, even though a university charter or rule prohibits secret research on campus.
151. *Letters and Other Writings of James Madison*. Vol. 3 (Philadelphia: J. B. Lippincott, 1865), pp. 140–141.

Mr. WALGREN. At a later point we will be joined by Congressman Dan Glickman, who is the chairman of the Subcommittee on Transportation, Aviation and Materials. Mr. Glickman has a strong interest in this issue in general, as well as a particular responsibility with respect to the area of advanced materials research. He will be here at some point this morning and we want to recognize that.

I would like to ask the other members of the panel here if they would like to make any opening comments at this point.

Mr. Gore.

Mr. GORE. Thank you, Mr. Chairman. I have a brief statement.

The United States has long enjoyed the benefits that have flowed from the competitive edge it possesses in many sectors of science and technology. Our preeminence in electronics, biology, and the physical sciences, to name only a few, have had enormous importance to us. Our system of research is truly a national resource. Therefore, public policy measures affecting that system deserve our careful consideration.

For these reasons, the Subcommittee on Investigations and Oversight, and the Subcommittee on Science, Research and Technology, chaired by my friend and colleague, Doug Walgren, have maintained a longstanding interest in how measures designed to restrict the flow of our know-how to the Eastern bloc might affect our structure for research.

Two years ago these two subcommittees convened to examine a draft Executive order that proposed placing unprecedented restrictions on the classification of basic scientific research. Coupled with statements by various administration officials, the proposed order had led to a concern in the scientific community that academic science in this country could be harmed by unnecessary restriction on scientific communication.

As a result of that proceeding, and the concern in the relevant professional communities, the National Academy of Sciences convened a committee to evaluate how to strike a balance between legitimate concerns about the effect of the flow of technology on national security and censorship of the scientific community.

The findings of that committee, known as the Corson report, adopted the position that under certain circumstances restrictions on science were justified, but that any broad or general controls over basic research were likely to be counterproductive. It was the assumption by many here in Congress that the Academy's efforts had settled the matter. Unhappily, we find that that is not the case.

So today we convene again to examine yet another effort by the Department of Defense to extend significantly more stringent control over publication by contractors and grantees. These proposals have precipitated another controversy, leading the heads of two major research institutions to publicly declare their willingness to forgo DOD research support rather than submit to censorship.

There is, indeed, legitimate cause for concern about the flow of militarily sensitive technology. This concern should and must be taken seriously. However, we need to be sensitive as well on how we attempt to stem unwanted technology flow, for if the measures are too broad, we run the risk of damaging our system of research which produced the preeminence we seek to guard.

I want to thank our distinguished witnesses for taking the time and trouble to appear here today, and I look forward to a timely and needed discussion.

[The prepared statement of Mr. Gore follows:]

STATEMENT OF HON. ALBERT GORE, JR., CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

Good Morning. The United States has long enjoyed the benefits that have flowed from the competitive edge it possesses in many sectors of science and technology. Our preeminence in electronics, biology and the physical sciences, to name a few, have had enormous importance to us. Our system of research is truly a national resource, and therefore public policy measures that affect that system deserve our careful consideration.

For these reasons, the Subcommittee on Investigations and Oversight and the Subcommittee on Science, Research and Technology, chaired by my friend and colleague Doug Walgren, have maintained a longstanding interest in how measures designed to restrict the flow of our know-how to the Eastern bloc might affect our research structure.

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Unhappily, that is not the case, and so today we convene again to examine yet another effort by the Department of Defense to extend significantly more stringent control over publication by their contractors and grantees. These proposals have precipitated another controversy, leading the heads of two major research institutions to publicly declare their willingness to forego DOD research support, rather than submit to censorship.

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I want to thank our distinguished witnesses for taking the time and trouble to appear here today, and I look forward to such a timely and needed discussion.

Mr. WALGREN. Thank you, Mr. Gore.

Mr. Durbin.

Mr. DURBIN. No comments.

Mr. WALGREN. Mr. Gregg.

Mr. GREGG. Nothing, Mr. Chairman.

Mr. WALGREN. As our first witness today, and on behalf of the committee, I want to welcome Congressman Ed Zschau who comes from the mid-peninsula area of California. Mr. Zschau has been very active in areas of policy questions surrounding technology development. He brings a great deal of experience as a former business leader, the chief executive of a successful high technology firm that has been involved in this area, and who in the Congress has developed a continued interest in this area. So we really appreciate your being able to come and join with us in this hearing.

Welcome to the committee, and you may proceed.

STATEMENT OF HON. ED ZSCHAU, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. ZSCHAU. Thank you very much, Mr. Chairman. I want to thank you and our colleague, Mr. Gore, for calling these hearings. I want to commend you for holding them because I think that this issue of how we maintain our technological leadership and have a strong national security posture as well is a critical issue that we're facing.

You have a line up of distinguished witnesses due to follow me, so I will be quite brief and just provide an overview.

As Mr. Gore just pointed out, I believe we should consider U.S. technological leadership as a national resource, something to be preserved, something to be protected, something to be enhanced. It has been responsible for an enormous amount of our economic growth. As a matter of fact, a study in the 1950's by the Massachusetts Institute of Technology estimated that 80 percent of our economic growth over the 40-year period of 1909–49 was due to technological change, technical progress. In addition, our technological leadership is obviously critical for national security. To maintain a strong defense, we have to employ technology, we have to employ finesse, in order to make sure that we are able to protect our national interests.

As you pointed out, Mr. Chairman, I do have the privilege of representing an area that has become a symbol of our high technology leadership, technological advancement. It is often called the Silicon Valley area. It was there that in 1905 Lee DeForest invented the vacuum tube that became the foundation for the electronics industry in the early part of this century. It was there that two graduates of Stanford University, Bill Hewlett and Dave Packard, started a company in a garage that became a multibillion dollar company, a leader in the electronics field.

It was there that William Shockley came after he left Bell Telephone Laboratories to start up a little laboratory, Shockley Labs, to exploit the transistor, a new invention for which he and others received the Nobel Prize. To Shockley Labs were attracted a group of engineers, among them Bob Noyce. Noyce got the idea that perhaps more than one transistor could be put on a single chip. As the coinventor of the integrated circuit, he founded a company, Fairchild Semi-conductor Corp., that became the patriarch of the many semiconductor firms in the area.

But then the group out of Fairchild got the idea that perhaps a whole computer could be put on chip. The microprocessor was conceived there. Noyce and others founded Intel Corp. to exploit that idea.

It was there around Stanford University that a group of hobbyists formed the Home Brew Computer Club in the 1970's, putting a microprocessor with an ordinary television set, with a keyboard. The idea of the personal computer developed there. In that club were two young men, Steve Jobs and Steve Wazniak. They got the idea of exploiting this—building a personal computer and founded in their garage Apple Computer Corp., now nearly a $1 billion corporation.

Al Shugart left IBM to start a company, Shugart Associates, to make flexible disks. It was there that John Linville, an electrical engineering professor, who had a daughter who was blind, wanted to give her the opportunity to read printed pages. He developed a device where she could feel the shapes of characters as this device went across the printed page. The Opticon was invented by him. Exploited by a Stanford engineering professor, Jim Bliss, a company, Telesensory Systems, was developed there.

It was there that DNA research took place and out of that came the whole field of genetic engineering.

It has been a hotbed of technological innovation right in one place. As a matter of fact, one of the major television networks, I am told, is going to have a "soap" about Silicon Valley being introduced this fall. I am not sure what it's going to be called, but it promises to tell the story of "technology and lust" in the area.

I know we have been good when it comes to technological innovation, but frankly, based on personal experience, I don't think we're competitive when it comes to lust. I think there are other places that are much better.

Having said all of this about the phenomenon of this place, the question is, Why did it happen? Why did it happen there? How can we make it happen elsewhere?

It is hard to know all of the details. I think that Dean Frederick Termin, who was head of the Engineering School at Stanford, was primarily responsible for his engineering students going out to become entrepreneurs. Bill Hewlett and Dave Packard were just two examples of that. They maintained a close relationship between the industry and the university.

There is an entrepreneurial spirit. If you haven't started a company by the time you're 35 years old, people begin to wonder what's wrong with you. And as these companies start, the people who found them, the innovators, provide examples for others who follow them.

But I think the main reason, the generic reason, why that was able to happen there is that there was freedom, scientific exchange, mobility of people, and there were incentives to do it. It was that environment in that area that we have got to preserve and enhance.

That leads me, Mr. Chairman, to three observations on the issue that these hearings are concerned with and, in addition, I would like to express one concern.

Observation 1. It has been the commercial developments in microelectronics, in various technology areas, done by entrepreneurs in the private sector, that have provided the technical foundation for our military capability. Many people have the mistaken belief that it has been the enormous amounts of moneys that we have expended in DOD-sponsored research that created the technical foundation for our defense systems. But you can go through the whole set of fields—in microelectronics, telecommunicatcns and so forth—and it has been the private sector, the Bob Noyces, the William Shockleys, and the Herb Dwights—he started a laser company—that did the research and development, that provided the foundations for our military capability.

Observation 2. The United States is no longer the sole source of technological innovation. It is happening throughout the whole world, and we have to recognize that. We're not the "Lone Ranger" when it comes to high technology any more. That is reflected by the patents that are being filed around the world and the sources of new products that are coming from overseas.

Observation 3. I think it's the most fundamental. Attempts to restrict the free flow of scientific information cannot be successful in a free society. When scientists get together, they are discussing their new ideas. These ideas may have enormous impact on national security, but they're focused on basic research. They may call up a colleague in England or in Germany or somewhere else and discuss these ideas, or exchange letters, because that is the way in which innovation takes place, through the fomenting of ideas. If we are to try to restrict that exchange of scientific information, given that we have modern telecommunications and facsimile systems and teleconferencing systems—the modern communications systems these days—we are only going to be successful if we keep people from talking to one another. But that cannot happen in a free society.

But a follow-on is the extent to which activities attempt to restrict this flow of scientific information they will be counterproductive. That is, if we try to restrict it, make it more difficult, we will have eliminated the prerequisite for technological advancement, which is this freedom—this ability to communicate, exchange ideas and be encouraged to innovate. So that leads me to a concern.

I feel concerned about the fact, at least as I observe the Washington scene, that there are those who fail to understand this process of technological innovation. As a result of not understanding it, feel they can try to restrict the freedom and the incentives in the scientific community and do so in the name of national security. If they do so, I feel we'll be killing the goose that lays the golden egg. We will be killing the very thing that has given us the technological leadership that Congressman Gore referred to as this national resource.

Let me give you an example. The Export Administration Act is now in conference between a House version of the bill and a Senate version of the bill. One part of the Senate bill contains language which previously, in the existing act, had excluded educational institutions. That language requires a reporting of any agreements between U.S. entities and foreign concerns in certain countries involving the transfer of unpublished technical data. But in the Senate version of the act that restriction is eliminated—that waiver is eliminated—and now educational institutions would fall under these export controls if the technology is on the militarily critical technologies list.

Well, there are two problems with that. One, is the militarily critical technologies list doesn't exist in entirety. It is still being put together. But second, it is confidential. It's a secret document. So essentially we would be requiring, if that provision stayed in the bill—which I hoped it doesn't—educational institutions to begin reporting if they were transferring technical data that was militarily critical, but they don't have a way of knowing whether or not it is. It is that kind of action that is meant with good intention, in order

to strengthen our national security, that I think will actually undermine it.

In conclusion, Mr. Chairman, let me just suggest that I think it's important that we here in the Congress and those in Washington that are in the position to make policy understand what has actually enabled us to be a leader in technology. It is this environment for innovation that has done that. We should do everything we can, not only with our national security provisions and controls on data, but our tax policy, regulatory policy, trade policy, education policy, to preserve and enhance that environment. That's really our strength. As we take action to protect information that is militarily critical, we should be very cautious and careful that it does not undermine or destroy the environment that has enabled us to be a technological leader in the past.

Thank you very much, Mr. Chairman. I would be happy to answer any questions that you or members of the committee might have.

Mr. WALGREN. Thank you, Mr. Zschau. We appreciate having your views as a knowledgeable comment on this area.

Let me just ask whether in the area of idea exchange, as opposed to exporting physical things, whether you think that there ought to be controls and limitations that the Export Administration Act ought to reach? It would not go into that area; is that right?

Mr. ZSCHAU. It makes an attempt to go into that area, and the "camel's nose under the tent" is this requirement to notify or report in the event that technical data, even of an unpublished nature, is exchanged to certain countries.

What I am warning against is that that provision and extensions to it, where we have already seen where extensions have been proposed, will undermine the environment that I feel is important for technological innovation. So, in answer to your question, the Export Administration Act typically deals with things, but its scope has begun to be expanded, and I am hopeful we will not allow that to happen.

Mr. WALGREN. It is also true that our university communities these days are really international in their reach. Has that not become such a factor that it may be almost self-defeating to try to cut off knowledge crossing international boundaries at that point?

Mr. ZSCHAU. I would agree with you, with the deletion of the word "almost." I think it would be self-defeating.

Mr. WALGREN. Congressman Gore.

Mr. GORE. I just want to thank you for your testimony. I think a lot of us on both sides of the aisle realize that you speak with special authority and expertise on these issues and we benefit from your considered judgments. I think your statement is excellent and you answered the questions I had in your statement. I appreciate you appearing here.

Mr. ZSCHAU. Thank you.

Mr. WALGREN. Do other members have questions?

Mr. GREGG. I would just like to congratulate Mr. Zschau for being here. He does an excellent job and I am in total agreement with what he says. Whatever he says on this subject, I'm in total agreement with. [Laughter.]

Mr. ZSCHAU. Thank you, Mr. Gregg.

Mr. WALGREN. Let me underscore, on behalf of the other members of the committee, how much we do appreciate your interest in the area. All of us don't really focus on many areas and it is helpful to have somebody, by background and by interest, who is focused on this area. We appreciate it.

Mr. ZSCHAU. Thank you very much, Mr. Chairman.

Mr. WALGREN. There is a vote just noticed on the floor. Rather than get started with one panel and then have to break off so quickly, perhaps now is the right time to break. So why don't we just take a short recess for 10 minutes and we will be back in that period of time and ready to go with the first panel at that point.

[Whereupon, the subcommittees were in short recess.]

Mr. WALGREN. Let me call us back to order. I apologize for the interruption. It is likely to happen throughout the morning and members will be coming and going.

I would like to introduce for the record the first panel that we have this morning, made up of Dr. Dale Corson, who is the chairman of the Government-University-Industry-Research Roundtable of the National Academy of Sciences, the head of the body which delivered what has become known as the Corson Report; Dr. Paul Gray, the president of the Massachusetts Institute of Technology; and Mr. Tom Ehrlich, the provost of the University of Pennsylvania, erstwhile of Stanford University and my own school of loyalty.

Welcome to the committee. We really appreciate people of your stature coming and making themselves available to contribute to our record.

Written statements and other things you feel you would like to submit in writing will be made a part of the record and you may feel free, please, to communicate the concerns and thoughts that you feel are most important in whatever way you feel are most effective. Again, we do appreciate your coming.

Let's start with Dr. Corson at this point.

STATEMENTS OF DR. DALE R. CORSON, PRESIDENT EMERITUS, CORNELL UNIVERSITY, AND CHAIRMAN, GOVERNMENT-UNIVERSITY-INDUSTRY-RESEARCH ROUNDTABLE; DR. PAUL E. GRAY, PRESIDENT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; AND THOMAS EHRLICH, PROVOST, UNIVERSITY OF PENNSYLVANIA

Dr. CORSON. Mr. Chairman, members of the committee, my name is Dale Corson and I am the president emeritus of Cornell University. I served as chairman of the panel on scientific communication and national security, sponsored by the National Research Council, whose report of that panel was published in September 1982.

My purpose today is to try to define some of the important issues in the debate over technology transfer insofar as communication of scientific research results is involved and to say that I believe that present trends will inevitably weaken the American position in international science and technology.

My National Research Council Panel sought to understand the role of scientific communication and technology transfer to potential adversary nations. We sought to define appropriate control mechanisms and criteria for the application of these mechanisms

in the few cases where we believed control might be justified. In the 20 months since our report was published, the development of agreed-upon and uniform policies has yet to be achieved.

After studying the problems in depth, my panel concluded that there is a narrow research area where concern is reasonable and where some degree of control may be appropriate. This narrow area embraces those research activities where manufacturing technology is developed or is employed in the research itself. The microelectronics field is the obvious case.

My panel specified criteria for the identification of such "gray" areas, as we called them, where we believed that research results should be neither classified nor totally available to everyone in the world. These criteria were the following:

One, the technology is developing rapidly and the time from basic science to application is short; two, the technology has identifiable direct military applications, or is dual-use—that is, it has both civilian and military use—and involves production-related techniques; three, transfer of the technology would give the U.S.S.R. a significant near-term military advantage; and four, the United States is the only source of information about the technology, or other friendly nations that could also be the source, have control systems as secure as ours.

We believed that the research fields meeting these criteria are few in number. For those cases that do satisfy these criteria, we believed that the appropriate restrictions were the following:

One, prohibition of direct participation in government-supported research projects by nationals of designated foreign countries; and two, submission of stipulated manuscripts simultaneously to the publisher and to the Federal contract officer, with the Federal agency having 60 days to seek modification in the manuscript.

Prohibition against direct participation in the work is the important restriction. It is only by such direct participation over an extended period that someone can learn the details which are the critical parts of the work.

If research projects require controls more restrictive than these, the work should be classified and conducted with all the security controls that such classification includes.

This brings me to a major issue for this discussion. Why not classify gray area research projects and guarantee security? The answer is threefold:

One, to do so would seriously impede the progress of research in fields so classified; development activity can progress under classified conditions, but basic research is inevitably slowed if the free exchange of information and ideas is impossible.

Two, the major research universities are likely to abandon research fields where such classification is imposed; and three, given the above circumstances, university research projects cannot be classified without serious damage.

Let us return to the gray area concept and look at the controls that some Federal agencies have sought to impose. I will take a specific case involving a proposed $450,000 contract which the Air Force sought to award to Cornell University. The negotiations over this contract foundered on two proposed restrictions which were set forth in the following language:

The technical data * * * generated under this contract may be controlled by the International Traffic in Arms Regulations. Accordingly, the contractor agrees that it will obtain prior written approval before assigning any foreign national to perform work under this contract or before granting access to foreign nationals to any technical data provided by the government, or generated under this contract.

Cornell declined to accept these terms for reasons I will discuss. Are the universities being unreasonable in taking such stands? Let me quote from a letter to the contracting agency from the vice president for research at Cornell. He says,

I would like to assure you that Cornell University intends that all its research programs should be carried out in compliance with all Federal and state laws, including the International Traffic in Arms regulations and any other applicable codes. Despite this, the wording you propose presents us with a problem.

We can accept a requirement that we obtain prior written approval before assigning any foreign national to perform work under the contract. The problem lies in our agreeing to obtain prior written approval before granting access to foreign nationals to any technical data generated under this contract. It would be quite easy to limit access of foreign nationals to technical data provided by the government, but to limit the access of members of the immediately associated research community in the Department of Electrical Engineering would be impossible. As of the fall of 1983, there were 13 foreign nationals engaged in research in that department. Even if we were willing to attempt to limit access to information and communication within the unit, I do not think it would be possible for us to do so.

These statements represent the position of one major research university.

I want to add some words of my own here about the importance of foreign nationals in American science and engineering programs. For many years the number of foreign students enrolled in our Ph.D. programs has been growing, and now, in engineering, it approaches 50 percent. Research positions and junior faculty positions in American universities are increasingly filled with these foreign products of our own graduate programs. As long as the flow of such people is assured, we need not worry about the quality of the staffs and faculties of our research institutions. However, if that flow is cut off, for whatever reason, we are in trouble. Foreign nationals must continue to be welcome in our graduate programs and they must have access to the seminars, professional meetings, and informal discussions about research programs.

Perhaps the problems over access to technical data generated in the project, as specified by the Air Force in the proposed Cornell contract, could be resolved if the words "foreign nationals" were changed to "designated foreign nationals." This would provide an opportunity to exclude those from adversarial countries, while providing access to everybody else. Perhaps the problem could be resolved at the visa level, so that undesirable foreign nationals would not be admitted to the country and the universities would not have to exclude anyone.

The Air Force contract rejected by Cornell invoked the International Traffic in Arms Regulations. I want to record my own objections and that of my panel to the use of export regulations to control scientific communication. The export regulations were developed to control the export of tangible objects, things that can be seen and felt and counted. They are not readily adaptable to seminar discussions, where foreign nationals may be present, or to research projects which may or may not produce critical technical data, or to classroom situations with foreign nationals present, or

in the case of the graduate student discussing his research project informally with other graduate students, one of whom may be a foreign national.

In the case of the Export Administration regulations, there is the further complication of the militarily critical technologies list. This all inclusive and cumbersome document, which is to be consulted in the development of any future commodity control list, is classified. The investigator who is concerned about violation of these regulations, with their heavy penalties, will not be able to know the basis of a possible violation.

I will raise one more issue, that of "creeping grayness." My panel believed that the number of gray research areas where some form of restriction could be justified is very small. There appears to be a growing interest in extending the concept of grayness to ever more areas, areas designated as critical or sensitive or emerging. We must limit the gray concept to as few areas as possible. We must have carefully thought out criteria to decide if an area needs gray treatment. If we let the gray concept go far, our own progress will inevitably be impeded.

So where do we stand 20 months after the Corson panel? The Government has not found it possible to adopt the recommendations of my panel. There is no overall Government policy bearing on the control of scientific communication, although there have been attempts to develop one. The Department of Defense is divided within itself over the proper approach. If the present trends continue, it may well be that administration of the gray area concept is unworkable. In that case, only a black and white solution is possible—completely open research and classified research.

A few universities will accept classified research on their campuses. Most major universities will not. Some may be willing to build classified facilities off campus and accept the classified work there. If the work is classified, however, progress will be impeded.

If we go to a black and white system, and if the fields falling within the gray area definition remain totally open, progress can continue as at present, but potential technology laws can be controlled only with the export regulations, with all the unfortunate consequences I discussed.

Federal agency concerns led to the gray area concept in the first place, and those concerns will not go away, so the gray area fields are likely to be classified with the penalties I have outlined. It appears to me that by failing to develop a workable system based on the gray area concept, we are painting ourselves into a corner. However, if we cannot implement a gray area system, we will serve the national interest best by keeping all university research completely open.

Our goal should be the development of a set of technology transfer policies, including scientific communication, which will assure our country a vigorous, vital scientific and intellectual life, as well as a sound military position. We want a technological position second to none, and we want the maximum relative technological advantage over our potential adversaries. We must be sure that our research programs are conducted with an esprit that will attract the best young minds.

To achieve these goals, we cannot rely on a defensive strategy which penalizes ourselves at the same time it seeks to deny the benefits of our science to others. We gained our present dominant position by a vigorous and open research program. Let us continue to pursue the strategies which put us ahead in the first place.

Thank you.

[The prepared statement of Dr. Corson follows:]

STATEMENT BY

Dale R. Corson

Subcommittee
Science, Research and Technology
Investigations and Oversight
of
COMMITTEE ON SCIENCE AND TECHNOLOGY

May 24, 1984

Mr. Chairman, and members of the committees. My name is Dale R. Corson and I am the President Emeritus of Cornell University. I serve as Chairman of the Government-University-Industry-Research Roundtable. I served also as the Chairman of the Panel on Scientific Communication and National Security, sponsored by the Committee on Science, Engineering and Public Policy of the National Research Council, whose report was published in September 1982. My professional training was as a physicist.

My purpose today is to try to define some of the important issues in the debate over technology transfer, insofar as communication of scientific research results is involved, and to say that I believe present trends will inevitably lead to the weakening of the American position in international science and technology and to state once again what I believe to be rational approaches to some troubling problems.

My National Research Council Panel sought to understand the role of scientific communication in technology transfer to potential adversary nations. We sought to define appropriate control mechanisms, and criteria for the application of these mechanisms in the few cases where we believed that control might be justified. In the twenty months since our report was published there has been a great deal of discussion of the issues relating to scientific communication but the development of agreed-on and uniform policies has yet to be achieved, and few of our recommendations have been adopted.

Let me make it clear that I believe, on the basis of intelligence information made available to me, that we have a serious problem in the loss of important technology to potential adversaries. I believe that we should exercise every means at our disposal to prevent that loss. At the same time, I also want to make it clear that scientific communication about research is contributing little to that loss, and that restrictions on our ability to communicate freely will seriously jeopardize rapid progress in fields which are of vital importance to our national welfare.

After studying the problems in depth, my Panel concluded that there <u>is</u> a narrow research area where concern is reasonable, and where some degree of control may be appropriate. This narrow area embraces those research activities where manufacturing technology is developed, or is employed, in the research itself. The microelectronics field is the obvious case. In order to produce experimental silicon chips for research

purposes, the same masking and lithographic techniques necessary in the manufacture of finished products must be used. It is the "recipes," or detailed specification of these processes, often involving more than 100 separate steps, that would give a potential adversary the opportunity to incorporate new technology into production items within one so-called "production cycle", say ten years.

My Panel specified criteria for the identification of such "gray" areas, as we called them, where we believed that research results should be neither classified nor totally available to everyone in the world. These criteria were the following:

1. The technology is developing rapidly, and the time from basic science to application is short;

2. The technology has identifiable direct military applications; or is dual-use (i.e. it has both civilian and military use) and involves process or production-related techniques;

3. Transfer of the technology would give the U.S.S.R. a significant near-term military advantage; and

4. The United States is the only source of information about the technology, or other friendly nations that could also be the source, have control systems as secure as ours.

We believed that the research fields meeting these criteria are few, in fact very few, in number. For those cases that do satisfy these criteria we believed that the appropriate restrictions were the following:

1. Prohibition of direct participation in government-supported research projects by nationals of designated foreign countries, and

2. Submission of stipulated manuscripts <u>simultaneously</u> to the publisher and to the federal contract officer, with the federal agency having 60 days to seek modifications in the manuscript. The right and freedom to publish remain with the university, as they do with all unclassified research.

Prohibition against direct participation in the work is the important restriction. It is only by such direct participation, over an extended period, that someone can learn the details of the "recipes", for example, which are the critical parts of the work. Federal agencies have sought to prevent foreign nationals from seeing laboratories and they have sought to prevent foreign nationals from enrolling in classes dealing with important fields such as computing technology and microelectronics. The

Panel did not believe that this latter kind of access presents any significant danger.

If research projects require controls more restrictive than these we proposed, the work should be classified and conducted with all the security controls that such classification includes.

This brings me to a major issue for this discussion: why not classify gray area research projects and guarantee security? The answer is three-fold:

1. To do so would seriously impede the progress of research in fields so classified; development activity can progress under classified conditions but basic research is inevitably slowed if the free exchange of information and ideas, which are so important to the nourishment of original thought, is impossible;

2. The major research universities are likely to abandon research fields where such classification is imposed, both because classification would impede progress and because classification is inconsistent with the academic environment; the case has not been made to the universities that there is a clear and present danger which demands classification of research on their campuses; and

3. Recognizing that more than half the nation's basic research is done in universities, and given the above circumstances, university research projects cannot be classified without serious damage.

Let us return to the "gray area" concept and look at the controls that some federal agencies have sought to impose. I will take a specific case, involving a proposed $450,000 contract, categorized as 6.2 applied research in the DoD scheme, which the Air Force sought to award to Cornell University. The negotiations over this contract foundered on two proposed restrictions and ultimately the Air Force terminated the discussions. The proposed restrictions were set forth in the the following language:

> "The parties acknowledge that the technical data....generated under this contract may be controlled by the International Traffic in Arms Regulations... Accordingly, the contractor agrees that it will obtain prior written approval from the Procuring Contracting Officer (PCO) before assigning any foreign national to perform work under this contract, or before granting access to foreign nationals to any technical data provided by the government, or generated under this contract."

Cornell declined to accept these terms, for reasons I will discuss.

The Presidents of Cal Tech, Stanford and MIT have informed the Defense Department and the President's Science Adviser that they also could not accept research projects with restrictions comparable to these.

Are the universities being unreasonable in taking such stands? Let me quote from a letter to the contracting agency from the Vice President for Research at Cornell, Dr. Robert Barker. He says, "I would like to assure you that Cornell University intends that all its research programs should be carried out in compliance with all federal and state laws. In this case, we intend to operate as specified in the International Traffic in Arms Regulations and any other applicable codes. Despite this, the wording you propose presents us with a problem."

Dr. Barker continues, "...I believe that we can accept a requirement that we obtain prior written approval before assigning any foreign national to perform work under this contract. ....As I see it, whether or not we receive funds from a federal agency or have a signed contract with a federal agency, we are still required to function so as not to contravene applicable federal laws which require us to assess the potential significance of our work in terms of National Security.

He continues, "The problem....lies in our agreeing to obtain 'prior written approval...before granting access to foreign nationals to any technical data generated under this contract.' It would be quite easy to agree to limit access of foreign nationals to technical data provided by the government, but to limit the access of members of the immediately associated research community in the Department of Electrical Engineering would be impossible. For your information, as of the Fall of 1983, there were 13 foreign nationals engaged in research in that department....Even if we were willing to attempt to limit access to information and communication within the unit, I do not think it would be possible for us to do so."

Those statements represent the position of one major research university.

I want to add some words of my own here, about the importance of foreign nationals in American science and engineering programs. For many years the number of foreign students enrolled in our Ph.D. programs has been growing and now, in engineering, approaches 50 percent. Research positions and junior faculty positions in American universities, especially in engineering, are increasingly filled with these foreign products of our own graduate programs. As long as the flow of such people is assured, we need not worry about the quality of the staffs and faculties of our research institutions. However, if that flow is cut off, for whatever reason, we are in trouble. Foreign nationals must continue to be welcome in our graduate programs, and they must have access to the seminars, professional meetings and informal discussions about research programs.

Perhaps the problem over access to technical data generated in the project, as specified by the Air Force in the proposed Cornell contract, could be resolved if the words "foreign nationals" were changed to "designated foreign nationals". This would provide an opportunity to exclude those from adversarial countries, constituting at most a very few percent of all foreign graduate students and post-doctoral fellows, while providing access to everyone else. Perhaps the problem could be resolved at the visa level, so that undesirable foreign nationals would not be admitted to the country and the universities would not have to exclude anyone. However, had such modified terms been developed in the Cornell case, it is likely the negotiations would ultimately have failed over control of publications.

My National Research Council Panel recommended that any necessary restrictions be administered through contractual terms rather than through Export Regulations. The Air Force contract rejected by Cornell University sought to administer the restrictions just as we suggested, but in so doing they invoked the International Traffic in Arms Regulations. I wish to record my own objection, and that of my Panel, to the use of export regulations to control scientific communication. The export regulations were developed to control the export of tangible objects, things that can be seen and felt and counted. They are not readily adaptable to seminar discussions, where foreign nationals may be present, to research projects which may or may not produce "critical technical data", or to classroom situations with foreign nationals present, when the instructor wishes to give the students the benefit of latest research results, or to the case of a graduate student discussing his research project informally with other graduate students, one of whom may be a foreign national.

In the case of the Export Administration Regulations there is the further complication of the Militarily Critical Technologies List. This all-inclusive and cumbersome document, which is to be consulted in the development of any future Commodity Control List, is classified. The investigator who is concerned about violation of the EAR, with their heavy penalties, will not be able to know the basis of a possible violation. EAR and ITAR do not alert investigators a priori that their work may be subject to control. There must be a better way.

I will raise one more issue, that of "creeping grayness". My Panel believed that the number of gray research areas, where some form of restriction could be justified, is very small. There appears to be growing interest on the part of sponsoring agencies to extend the concept of grayness to ever more areas—areas designated as "critical", or "sensitive" or "emerging". We must limit the "gray" concept to as few areas as possible. We must have carefully thought out criteria to decide if an area needs "gray" treatment. If we let the "gray" concept go far, our own progress will inevitably be impeded.

So where do we stand 20 months after the Corson Panel? One can draw several conclusions. For one, the government has not found it possible to

adopt the recommendations of my Panel. For another, there is no overall government policy bearing on the control of scientific communication, although there have been attempts to develop one. A set of disparate policies appears to be evolving in various federal agencies, especially within the Department of Defense, and that Department is divided within itself over the proper approach.

It appears to me that at a time when our scientific enterprise needs maximum vigor, it is being impeded by a growing set of over-restrictive controls. If present trends continue, it may well be that administration of the gray area concept is unworkable. In that case, only a black and white solution is possible: completely open research and classified research.

A few universities will accept classified research on their campuses. Most major universities will not. Some may be willing to build classified facilities off campus and accept the classified work there. If the work is classified, however, progress, even in the universities that will accept classified work, will be impeded and educational programs will be damaged.

If we go to a black and white system and if the fields falling within the gray area definition remain totally open, progress in the fields can continue as at present but potential technology loss can be controlled only with the export regulations, with all the unfortunate consequences I have discussed.

Federal agency concerns led to the gray area concept in the first place, and those concerns will not go away, so that gray area fields are likely to be classified, with the penalties I have outlined. It appears to me that, by failing to develop a workable system based on the gray area concept, we are painting ourselves in a corner. However, if we cannot implement a gray area system, we will serve the national interest best by keeping all university research completely open.

Our goal should be the development of a set of technology transfer policies, including scientific communication, which will assure our country a vigorous, vital scientific and intellectual life, as well as a sound military position to insure the stability we seek. We want a technological position second to none, and we want the maximum relative technological advantage over our potential adversaries. We must be sure that our research programs are conducted with an esprit that will attract the best young minds.

To achieve these goals we cannot rely on a defensive strategy which penalizes ourselves at the same time it seeks to deny the benefits of our science to others. We gained our present dominant position in world science by a vigorous and open research program. Let us continue to pursue the strategies which put us ahead in the first place.

Mr. WALGREN. Thank you very much, Dr. Corson.

I would like to go on with the other members of the panel and then come back for some discussion, but again we have another vote. I think, in deference to Dr. Gray, why don't we wait until we return. So we will excuse ourselves for 10 minutes.

[Whereupon, the subcommittees were in short recess.]

Mr. WALGREN. Let me call us to order.

I recognize Dr. Gray to proceed.

Dr. GRAY. Thank you, Mr. Chairman, and members of the committee. I am Paul E. Gray, president of the Massachusetts Institute of Technology. I am appearing on behalf of the American Council on Education, the Association of American Universities, and the National Association of State Universities and Land-Grant Colleges, as well as on behalf of MIT.

I thank the chairmen and members of the subcommittees for scheduling this hearing on scientific communication and national security. Constraints on scientific communication and export controls on technical data and information are of growing concern to the Nation's research universities, and I appreciate very much the opportunity to discuss this concern before these distinguished subcommittees of the Committee on Science and Technology.

I earnestly hope that in this discussion I will not contribute to what Dale Corson has referred to as "creeping grayness."

I would like first to organize my remarks around three propositions. First, we should avoid strengthening the military posture of unfriendly nations through the careless or unintended transfer of significant technology. Second, we should recognize that most mechanisms intended to limit technology transfer will have some effect on the system that produces innovation and technical advance. Third, we should develop and apply controls in a way that achieves some appropriate balance between these conflicting objectives.

I would like to begin with some comments about technology generation and technology transfer. There are, of course, many sources of technology generation—universities, Federal and industrial research laboratories, corporate research and development activities, and those myriad activities involved in the manufacture, production, distribution, and service of technical systems. Within these different kinds of organizations there is an equally broad range of activities, and there is some segregation of activities by sources. For example, much of the basic research in this Nation is performed in the research universities. In other areas of research and development, however, the segregation by source is less clear, and there is very broad overlap.

The unintended transfer of technology to unfriendly nations is said by some to represent a serious problem in the context of the security of the United States. Further, it is said that universities contribute to this unintended transfer through their international communities of students, faculty, and research staff, through the publication of results in the open literature, and through the intrinsic openness of university communities. University scientists can form no independent judgment of the validity or the magnitude of this possible problem, of course, because the data essential to the judgment are, perforce, classified. However, not one of the

examples of troubling transfer that I have heard of stems from the open nature of the university or from the open literature. All are due to theft, to espionage, or to the reexport of high technology items.

But even if transfers from the universities were some part of the problem—and this is far from clear to me—any potential disadvantage must be measured against the very great advantage to scientific progress and to the Nation of open scientific communication and research.

One might ask, in addition, about the importance of "leaks" from universities in comparison with those flowing from the licensed export of dual-use technologies, from the theft or unlicensed sale of restricted technologies, from the operations of multinational companies, and from disclosure to friendly nations and the like.

Any efforts to control technology transfer will have some impact on the research enterprise, and it is that question I would like to address next.

The quality and integrity of research are anchored in its nature as a dispersed, interdependent, and cumulative enterprise. Research is dispersed in that work at the frontier, in most fields, is carried on simultaneously in several different locations. It is interdependent in that different investigators or groups of investigators rely on work done elsewhere to validate and extend their own work.

The closer work is to the frontier of knowledge, and the more swiftly a field is developing, the more researchers depend on open and rapid communication with colleagues working on similar problems elsewhere. This dependence leads to the development of informal networks of communication that rely on working papers on preprints, and especially on personal communication. In a rapidly developing field, these informal mechanisms of communication assume the principal burden of communication among colleagues.

Research is cumulative in the sense that many small steps taken by individuals working in different places, under different auspices, contribute to new knowledge. Indeed, I would suggest that the leadership of the United States in fields as diverse as commercial cryptography and genetic technology has come about precisely because of the open, interdependent nature of research in American universities. In such endeavors, limitations on the communication of results obviously impede progress. I should also say that such secrecy is exceedingly difficult to achieve because so much of the communication that occurs is informal in character.

Beyond the impact that secrecy and constraints on information have on the effectiveness of research, there is another issue that is related to the character of research as it is carried out in U.S. universities. The United States comes close to being unique in the world in the degree to which it combines in one set of institutions the functions of education, particularly graduate education, and basic research. I suggest that this coupling produces enormous benefits to the country.

The coupling of education and research is fundamental to the research enterprise as it exists in universities, and that coupling needs to be considered when one looks at the impact of controls. Beyond this question there is the issue of having access in the uni-

versity research community to the ablest individuals. Universities are typically cosmopolitan communities, and that is not by accident. Talent does not come with a particular passport, and it is important that the university community has access to the ablest individuals, whatever their nationality.

Thus, it seems to me that if one limits either access to research or communication of research results, there are several immediate consequences. There is the loss of the corrective sort of feedback that normally arises when there is open communication. If there are limitations on access or on communication of results in university research, universities will be less able to attract the most competent people. Some people simply will not work in such areas if the results are restricted. More importantly, there will be a loss in the coupling of research and education.

These consequences do not occur from simple adherence to a principle. They reflect the practical difficulty which we in universities have in trying to limit anybody's access to what goes on in any particular corner of the place. It is very hard to do. In the end, there will be diminished quality of process and diminished quality of results.

As we think about the development of controls, particularly as they bear on technical data, it is crucially important that there be sensitivity to the subtleties that are involved. I have tried to suggest here some of those subtleties. There is a need for balance, a need for tailoring solutions which fit the problem. It is not a question of balancing off the national interests against academic freedom. Indeed, the national interest is served neither by excessive openness in terms of transferring information to unfriendly nations, nor by excessive controls that would have an untoward effect on the production of new ideas or innovation.

What are the considerations that ought to enter into the formulation of controls? It seems to me that one needs to consider the practical utility of information. One needs to recognize that technology transfer is a difficult and tortuous process, and that know-how is much more important than technical reports. One needs to recognize as well that information is perishable, that it has a finite lifetime. Its value decreases with time and the generators of knowledge, if they are reasonably expeditious in putting it to use, ought to have some innate advantage because of that perishable quality.

I would suggest that in the application of controls it is necessary to distinguish among the various intellectual ativities. Basic research needs to be treated in one way. Products, devices, prototypes—things—need to be treated in another. In addition, not all activities are amenable to such easy classification, particularly in those areas where the research frontier is very close to the applications frontier.

To summarize, I would say simply that it is important for us as a nation to try and strike a balance between objectives that are in conflict. The national interest lies not in either extreme, but in setting goals and policies which service both the cause of national security and the larger process of science and technology on which so much of this Nation's strength depends.

Thank you.

[The prepared statement of Dr. Gray follows:]

TESTIMONY OF PAUL E. GRAY, PRESIDENT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. Chairman, I am Paul E. Gray, President of the Massachusetts Institute of Technology. I am appearing on behalf of the American Council on Education, the Association of American Universities, and the National Association of State Universities and Land-Grant Colleges, as well as on behalf of M.I.T.

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But even if transfers from the universities were some part of the problem, and this is far from clear to me, any potential disadvantage must be measured against the very great advantage to scientific progress, and to the nation, of open scientific communication and research. One might ask in addition about the importance of "leaks" from universities in comparison with those flowing from the licensed export of dual-use technologies, from the theft or unlicensed sale of restricted technologies, from the operations of multinational companies, from disclosure to friendly nations, and the like.

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To summarize, I would simply say that it is important for us as a nation to try and strike a balance between objectives that are in conflict. The national interest lies not in either extreme but in setting goals and policies which serve both the cause of national security and the larger process of science and technology on which so much of this nation's strength depends.

Mr. WALGREN. Thank you very much, Dr. Gray. We appreciate that statement.

Let's turn to Mr. Ehrlich.

Mr. EHRLICH. Thank you, Mr. Chairman. I am pleased to be here, though I am deeply troubled by the proposed rules that occasion this hearing. In my own judgment, the direct result of those rules could be to hobble the benefits to this country of its great research universities. My appearance is on behalf of one of those, the University of Pennsylvania, where I serve as provost and professor of law. It includes about 1,800 members of its standing faculty and more than that number of associated faculty. Every single one of

them is potentially affected by these rules. Their possible impact on close to 20,000 undergraduate and particularly graduate students at the university is indirect, but is no less real.

With your approval, I will just summarize the key points in my written testimony and submit that for the record.

My major aim is to express, as forcefully as possible, as clearly as possible, my firm conviction that creating new knowledge does require not only skill and resources and time and talent but openness. For all the weaknesses of universities, if my colleague to my left will excuse me, they are the finest gardens we have for growing "gray matter." They are often inefficient, they are sometimes even wasteful, but they are the places where the inquiring mind works the best. It is that mind that continually asks whether there isn't a better way and reexamines a just-proved thesis because some new evidence may call it into question. It is that inquiring mind that performs best only when both it and its products are fully exposed. In a university where research and education are literally inseperable, that exposure is essential.

As you know, Mr. Chairman, those of us in academic life put a very high premium on disagreement. Every important issue is open to discussion, debate, and most important, to dissent. It is profoundly significant, therefore, that I know of no individual in academic life who disagrees with the basic concerns that I and my colleagues have expressed. Virtually alone among important public issues in recent times, the reactions of those in research universities is uniform and negative. I cannot overstate the dangers we see in the approaches that are being followed.

They focus on three major areas. First, the proposed Defense Department rules on nonclassified research results deemed "sensitive" by the Department; second, the current administration of the Export Administration Act, and particularly the proposed revision of that Act; and third, the National Security Directive 84, now temporarily suspended, which would require lifetime prepublication review for Government employees with access to classified information. A few comments, if I may, on each.

You well know the background of the proposed Defense Department restrictions, for they have been extensively publicized. As a matter of institutional policy, the University of Pennsylvania and its faculty do not conduct classified research. We do, however, engage in a good deal of unclassified research sponsored by the Department of Defense, and we believe that research is of direct and substantial benefit to the national interest.

Any restraint on the research findings that are, by definition, nonclassified, are antithetical to research at a university. The proposed Department of Defense restraints are particularly troublesome since, as you know, the term "sensitive" describing the research to be covered is undefined. Insofar as we can tell, sensitivity might be determined prior or subsequent to the negotiation of a grant or contract. An individual researcher might or might not be informed beforehand. The potential, therefore, for ad hoc or capricious judgments is obvious. But even more seriously, the direct result is likely to be the very opposite of the one intended. The best minds in universities can work only in atmospheres of openness. To the extent they move away from doing the kind of sponsored re-

search that is so much in our national interest, that national interest suffers. That is precisely what is likely to happen. Equally troublesome, the results of the research would not be subject to the kind of searching inquiry that is so important, and again, our national interests would suffer directly.

If full dissemination of research is to be limited by the Defense Department or by any other potential source of support, then the University of Pennsylvania would be unable to accept it. The result would be a major loss, not only to Pennsylvania and other great universities that adopt similar positions, but, far more important, a great loss to the country as a whole. In short, constraints of these kinds on the free flow of research information will lead precisely to the opposite effects than those intended. Although these rules are designed to protect America's technological leadership, the consequence would be to erode that leadership.

Our concerns are no less real concerning the second cluster of issues, those that involve the Export Administration Act. Even in its current form, administration of the act restricts scientific activities to the detriment of technological processes in this country. In my text submitted for the record, I give some examples of that. The proposed change in the act would exacerbate the problem substantially.

Currently, educational institutions have an unqualified exemption from the requirements of section 5(j) of the act, and we have seen no justification for reversing that policy. The proposed change in the law would both substantially broaden the current reporting requirements and make them applicable to educational institutions in cases "where the unpublished technical data involves a technology identified by the Secretary of Defense as militarily critical technology." Together, those restraints would impose a potentially devastating set of restrictions on the exchange of information among the research community that is so important to the national interest.

Again, the purpose is to protect America's technological superiority, but again, a far more likely result would be precisely the reverse—to isolate scientists in this country and to weaken our country's strength in technology.

There are serious ambiguities in the provision in question, now part of the Senate version being discussed in the House-Senate conference on the Export Administration Act. But were the Senate provision enacted, it seems that almost any agreement with an agency of a foreign government could fall within its ambit. The consequence would be to restrict the very kinds of research that our Federal Government very properly wants to promote. So I urge the House of Representatives to reject that proposed Senate version.

Finally, Mr. Chairman, I turn to National Security Decision Directive 84. Although, as you know, under pressure the administration withdrew the directive, it did so under circumstances that make it likely that it may well seek to reestablish it unless Congress precludes that step. Even more troubling are recent reports that an earlier version of the directive is currently in effect, with application to many thousands of Federal Government employees. In the strongest possible terms, I emphasize that the proposed di-

rective's prepublication requirement would have disastrous effects on the quality of our government in terms of those who enter and those who leave public service from academic life.

There are two broad categories of those consequences. First, the Federal Government does depend upon expertise from a wide range of different backgrounds, including those in universities. It is a distinctive virtue of our Federal Government that one in academic life may be called to serve for a period of years and then return to his or her college or university. Those faculty members bring their expertise, their insights, their analytic powers and experience, their unique resources. They are not the sole repository of talent, of course, but they are enormously important.

A main reason why men and women from academic life take time to serve in the Federal Government is, of course, because they feel an obligation to do so. It is also true that work in the Federal Government provides an opportunity firsthand to experience problems and to test ideas. Those of us in academic life are often accused of living in an ivory tower, and sometimes not without reason. Federal Government service offers a chance to gain a firsthand perspective on matters that a faculty member has been analyzing from afar. It is hardly surprising, therefore, that a key inducement of government service is that the firsthand perspectives, once again, will then be used in scholarly publications, in classroom lectures, and in many other ways as well.

Under the Presidential directive as proposed, far more than simply a chill would be cast over that inducement. The result would be no less than a deep freeze. Who could be sure that any particular piece of prose would not be found by some unidentified bureaucrat to contain some information that, if not classified, should be classified? I can't think of a single step that would be more likely to deter those in academic life from service in the Federal Government than this one.

But there is a second and maybe even more serious concern. I believe with some passion that good government depends on good criticism, and I know you do as well, Mr. Chairman. Those who served in the Federal Government from academic life, and have then returned to that life, are often in the best position to provide that criticism. This is not, of course, a matter of partisan politics. Over the last decades, thousands of men and women from our colleges and universities have served in Republican and Democratic administrations. When they return to their academic careers, the quality of our Federal Government was immeasurably benefited by their analyses of their predecessors and their successors.

Under the Presidential directive, the risk is very grave that those benefits would be impaired. I can't quantify the danger, but I can assure you that it is clear and it is present.

I can use my own career as a case in point. From 1962 to 1965 I had the privilege of serving in the State Department and subsequently I became a professor of law and then dean at Stanford Law School, as you know. Then I wrote and taught about international law and believe my own academic work was immeasurably strengthened by my years in the State Department.

In preparing for this testimony, I reviewed the books and articles I wrote at Stanford. Some were extremely critical of actions and in-

actions by the Johnson administration, and by subsequent administrations as well. Would those writings have withstood the scrutiny of the prepublication clearance as required by that Presidential directive? I don't know.

More recently I served as the director of the agency responsible for international economic development activities within our Government. Soon after I wrote an article spelling out a number of proposals about U.S. relations with Third World countries and raising a variety of concerns about the current administration's approach. During the course of my activities, of course, I had access to literally thousands of classified documents. Many related solely to economic conditions in one or more countries and, incidentally, most had no justifiable basis for being classified. In all events, I do not believe I ever misused classified information, but I could well imagine that someone, from some administration, might think so.

In fact, when an article I wrote on international economic development appeared, I received a very thoughtful, though very critical, letter from a staff member of the National Security Council commenting on that article. We had an exchange of views, and that is exactly the kind of exchange that ought to take place. But how tempting it would have been if one in the National Security Council could not only criticise my criticisms, but stop, or at least delay, their publication.

Mr. Chairman, finally, when I left law school I had the great good fortune to work as law clerk for Judge Learned Hand, among this Nation's greatest jurists, as you know. He was my mentor. He was the one who urged me particularly to teach. One of his most powerful speeches was made three decades ago, at the height of the McCarthy period. At this time and in this context, I think an excerpt bears repetition.

> The mutual confidence on which all else depends can be maintained only by an open mind and a brave reliance on free discussion. I do not say that these will suffice; who knows but we may be on a slope which leads down to aboriginal savagery. But of this I am sure; if we are to escape, we must not yield a foot upon demanding a fair field and an honest race to all ideas.

Mr. Chairman, in my judgment, and in the judgment of my colleagues, the directive and the other proposed rules at issue today would hobble that race beyond measure.

Thank you.

[The prepared statement, plus additional information requested of Mr. Ehrlich follow:]

TESTIMONY OF THOMAS EHRLICH

PROVOST, UNIVERSITY OF PENNSYLVANIA

before the

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

and the

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

of the

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

concerning

Scientific Communication and National Security

May 24, 1984

Mr. Chairman and members of the Committee:

I am pleased to appear before you, though deeply troubled by the proposed governmental rules that occasion this hearing. The direct result of those rules would be to hobble the benefits to this country of its great research universities.

My appearance is on behalf of the University of Pennsylvania, where I serve as Provost and Professor of Law. That University includes about 1800 members of the standing faculty, and more than that number of associated faculty. All of them are potentially affected by these rules. Their possible impact on the 19,000 undergraduate and graduate students at the University is indirect, but no less real.

I

My aim today is to express, as forcefully as possible, my clear conviction that creating new knowledge requires not only skill, resources, time, and talent, but openness. For all the weaknesses of universities, they are the finest gardens we have

for growing gray matter. They are often inefficient, sometimes even wasteful, but they are the places where the inquiring mind works best. It is this mind that continually inquires whether there is not a better way and reexamines a just-proved thesis because new evidence may call it into question. The inquiring mind can perform best when both it and its products are fully exposed.

Openness is not the only requisite for producing new knowledge. Risk taking is certainly another. Fail-proof research is trivial-in the hypothesis to be tested or the mode of testing or both. Other requisites are also obvious, not the least of which are brain power and imagination. But openness is key to the mind-set for which the only absolute is that there are no absolutes; the mind-set that is ever skeptical though never cynical; and most of all, the mind-set that is always prepared to subject any judgment to searching scrutiny, with full realization that the judgment may be enriched with new evidence -- but also may be exposed as wrong.

Politics is alive and well in the academic realm as in Washington, but no one in a university would think of shaping research results to please a president or provost. If anyone did, the requirement of openness would show up the shenanigans.

The operational consequences of this requirement of openness can be simply stated: Do not inhibit, do not restrict, do not stifle. With sadness, I express my firm judgment that the governmental efforts that are the subject of these hearings do all three.

As you know, Mr. Chairman, those of us in academic life put a high premium on disagreement. Every issue is open to discussion, debate, and - most important - disagreement. It is profoundly significant, therefore, that I know of no individual in academic life who disagrees with the concerns I here express. Virtually alone among important public issues in recent times, the reaction of those in universities is completely uniform and completely negative. I cannot overstate the dangers we see in the approach that is being followed.

That approach is focused on three main areas: first, the proposed Department of Defense restrictions on non-classified research results deemed "sensitive" by the Department; second, the current administration of the Export Administration Act and the proposed revisions of that Act; and third, National Security Directive 84, now temporarily suspended, which would require lifetime pre-publication review for government employees with access to classified information. I comment briefly on each.

II

The background of the proposed Department of Defense restrictions has been extensively publicized, and I need not review it here. As a matter of institutional policy, the University of Pennsylvania and its faculty do not conduct classified research. We do, however, engage in unclassified research sponsored by the Department of Defense, and we believe that this research is of a direct and substantial benefit to the national interest.

The guidelines proposed by the Defense Department's subpanel on International Technology Transfer would require any proposed publication of research findings deemed "potentially sensitive" to be submitted to the department for review and comment 60 days prior to publication, if the research is to be conducted under sponsorship of the Department's 6.1 basic research program. Applied research and advanced development designated as "non-sensitive" would be required to be submitted to the department for review and proposed revision by the contract monitor. For applied research or advanced development designated "sensitive," proposed publication would have to be submitted to the Department for approval 90 days in advance.

Any restraint on research findings that are, by definition, nonclassified, is antithetical to research at a university. These restraints are particularly troubling since the term "sensitive," describing the research to be covered by these proposed guidelines, is undefined. Insofar as we can tell, "sensitivity" might be determined prior or subsequent to the negotiation of a grant or contract. An individual researcher might or might not be informed. The potential for ad hoc and capricious judgments is obvious. Most seriously, the direct result is likely to be the very opposite of the one intended. The best minds in universities can work only in the atmosphere of openness I described. To the extent they move away from doing sponsored research that is in our national interest, that interest suffers. This is precisely what is likely to happen. Equally troublesome, the results of the research would not be subject to the kind of searching inquiry that is so important. Again, our national interests would suffer directly.

In discussing this area with several researchers, illustrations were suggested of the dangers involved. None of those with whom I talked, however, wanted these illustrations used - lest they become self-fulfilling propheses, with previously uncensored research results suddenly subject to restriction on the alleged ground of "sensitivity."

If full dissemination of research is to be limited by the Defense Department, or by any other potential source of support, then the University of Pennsylvania would be unable to accept that support. The result would be a major loss, not only to Pennsylvania and the other great universities that adopt similar positions, but to our country as a whole. In short, constraints of these kinds on the free flow of research information will lead to precisely the opposite effect to that for which they are intended. Although these rules are designed to protect America's technological leadership, the consequence will be to erode that leadership.

III

Our concerns are no less real concerning the proposals to amend the Export Administration Act. Even in its current form, administration of the Act restricts scientific activities to the detriment of technological progress in America.

I offer a simple example. As you may know, under the regulations implementing the Export Administration Act, universities are required to complete an extensive form concerning any Soviet scholar who seeks to come temporarily to the United States. One of the great strengths of the University of Pennsylvania is in biomedical electronics, and

recently a Soviet scientist named Dr. Simakov applied to work in America on biomedical microsensors and processing systems. He listed University of Pennsylvania as his first choice. My colleagues in Penn's Center for Chemical Electronics think they could learn substantially from Dr. Simakov - at least as much, and probably more, than he could learn from us. Perhaps most important, working together in the realm of sensors, major developments may well occur. The area is recognized by the National Science Foundation as vital.

In order for Dr. Simakov to come, my colleagues would have to affirm that there would not be dissemination to him of information "directly and significantly related to design, production, and utilization in industrial processes." As a result, although Dr. Simakov could contribute greatly to work of enormous importance in this country, in all likelihood he will not be able to come. Ironically, I understand we do not now have a clear picture of Soviet research efforts in the field of sensors. It would obviously be useful to have a window into that field at a major research institute within the Soviet Union. I am told that any potential transfer out of the United States would be small compared to the gain to the United States.

The proposed change in the Export Administration Act would exacerbate these and similar problems substantially. Currently, educational institutions have an unqualified exemption from the requirements of Section 5(j) of the Act, and no justification for reversing that policy has been demonstrated. The proposed change in the law would both substantially broaden the current reporting requirements and make it applicable to educational institutions in cases "where the unpublished technical date involves a technology identified by the Secretary of Defense as a militarily critical technology." Together, these revisions would impose a potentially devastating restraint on the exchange of information among the research community.

Again the effort is to protect America's technological superiority. Again, a far more likely result would be precisely the reverse - to isolate scientists in this country and weaken America's strength in technology. There are ambiguities in the provision in question, now part of the Senate version being discussed in the House-Senate Conference on the Export Administration Act. But were the Senate revision enacted, it seems that any agreement with an agency of a foreign government could fall within its ambit. The consequence would be to restrict the very kinds of research that our federal government quite properly wants to promote. In the strongest possible terms, I urge that the House of Representatives reject the proposed Senate version.

IV

Finally, Mr. Chairman, I turn to National Security Decision Directive 84. Although, under great pressure, the Administration withdrew that directive until after the election, it did so under circumstances that seem to make it likely that the Administration may seek to reestablish the Directive after November unless Congress precludes that step. Even more troubling are recently published reports that an earlier version of the Directive is currently in effect, with application to many thousands of federal government employees. The Directive contains two key provisions that trigger our deep concern.

First, paragraph 1.b. of the Directive requires that "all persons with authorized access to Sensitive Compartmented Information (SCI) shall be required to sign a non-disclosure agreement as a condition of access to SCI and other classified information. All such agreements must include a provision for pre-publication review to assure deletion of SCI and other classfified information."

Paragraph 1.a of the Directive requires "all persons with authorized access to classified information ... to sign a nondisclosure agreement as a condition of access." Although

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this paragraph does not actually require pre-publication review as does paragraph 1.b.,the remedies for breach of each paragraph are exactly the same and the implementing regulations make plain that all signatories to paragraph 1.a. would be justified in acting as though a pre-publication review requirement applied to it as well. Although my subsequent comments will focus exclusively on paragraph 1.b., therefore, the concerns I express apply to the Classified Information Disclosure Agreement as well.

Under the SCI Nondisclosure Agreement Form to be required of government employees, and presumably others with access to classified information under government contracts, pre-publication review is required of "all materials, including works of fiction .... prepared for public disclosure, which contain or purport to contain: (a) any SCI, any description of activities that produce or relate to SCI, or any information derived from SCI; (b) any classified information from intelligence reports or estmates; or (c) any information concerning intelligence activities, sources or methods."

It is hard to imagine a broader definition of materials that must be screened by unnamed and unidentified government officials. As the Justice Department's implementing regulations make clear, coverage is not limited to classified

information , but includes any information that is "required to be considered for classification pursuant to Executive Order 12356, Section 1.3(a)(4)." Further, even if no classified or classifiable information is actually contained in a proposed publication, pre-publicaton review is still required in an incredibly broad spectrum of circumstances. Even oral statements in a classroom or otherwise - are covered if they "may contain SCI or other classified information." A caveat is included concerning "material that consists solely of personal views, opinions or judgments ...." It is immediately overridden, however, by this exception to the caveat: "of course, in some circumstances the expression of 'opinion' may imply facts and thus be of such a character as to require prior review."

I could go on in more detail, but I know that this Committee and the Committee on Government Operations have received extensive analyses of the Directive from others as well. As a lawyer and law professor, I could also join with those raising the most fundamental questions about the constitutionality of the provisions I have just cited. Others, however, more expert than I in constitutional law, have given compelling testimony on that score.

My role today is to emphasize, in the strongest possible terms, why the proposed Presidential Directive and its pre-publication requirement will have disastrous effects on the quality of our government in terms of those who enter and leave public service from academic life. Those consequences can be clustered in two broad categories.

First, the Federal Government depends on expertise from a wide range of different backgrounds, including those in academia. It is a distinctive virtue of our federal government that one in academic life may be called to serve for a period of years and then return to her or his college or university. Those faculty members bring expertise and insights, analytic powers and experience, that are a unique resource. Colleges and universities are not the sole repository of talent, but they are an enormously important one.

A main reason why women and men from academic life take time out to serve in the federal government is, of course,because they feel an obligation to do so. It is also true, however, that work in the federal government provides an opportunity to experience problems and to test ideas on a first-hand basis. Those of us in academic life are often accused of living in an ivory tower, and sometimes not without reason. Federal government service offers a chance to gain a first-hand

perspective on matters that a faculty member has been analyzing from afar. It is hardly surprising, therefore, that a key inducement of government service is that the first-hand perspectives, once gained, will be then used - in scholarly publications, in classroom lectures, and in other ways as well.

Under the Presidential Directive, far more than simply a chill would be cast over that inducement. The result would be no less than a deep freeze. Who could be sure that any particular piece of prose would not be found by some unidentified bureaucrat to contain some information that, if not classified, should be classified? I can think of no single step that would be more likely to deter the best of those in academic life from service in the federal government than this one.

There is a second, and perhaps even more serious concern. I believe with some passion that good government depends on good criticism. Those who have served in the federal government from academic life, and have then returned to that life, are often in the best position to provide that criticism. This is not, of course, a matter of partisan politics. Over the last decades, thousands of women and men from our colleges and universities have served in Republican and Democratic administrations. When they return to their academic careers, the quality of our federal government is immeasurably benefitted by their analyses of their predecessors and successors.

Under the Presidential Directive, the risk is grave that these benefits would be seriously impaired. I cannot quantify the danger, but I can assure you it is clear and present.

If I may, Mr. Chairman, let me use my own career as a case in point. During 1962 to 1965, I had the privilege of serving in the Department of State, as special assistant first to the Legal Advisor and then to the Under Secretary of State. Suybsequently, I became professor of law and then dean at Stanford University. I taught and wrote particularly about international law, and believe my academic work was immeasurably strengthened by my years in the State Department.

In preparing for this testimony, I reviewed the books and articles that I wrote during my years at Stanford. Some were extremely critical of actions and inactions by the Johnson Administration, and by subsequent Administrations as well. Would those writings have withstood the scrutiny of the pre-publication clearance required by the Presidential Directive? I do not know.

In working with Under Secretary George W. Ball, I had access to a great deal of classified information about United States' involvement in Viet Nam. In the years after I went to Stanford in 1965, I spoke out against United States military involvement

in Viet Nam. It does not take much imagination to craft an argument that my "opinions" were based on "facts" - using the words of the Justice Department interpretations - to a degree that would have made it very tempting for those in the Johnson and then the Nixon Administration to seek my silence.

I wrote a book about the international legal aspects of the crises in Cyprus from 1964 to 1974. My initial knowledge of the problems on that unhappy island came during my State Department years. Subsequently, while I was teaching and writing at Stanford, American policies changed concerning Greece, Turkey, and Cyprus a good many times. It does not seem to me paranoiac to suggest that some might have found my book inappropriate for publication.

More recently, I served as the first Director of the International Development Cooperation Agency, with responsibilities for United States policies concerning international economic development. Soon after I left that position, I wrote an article spelling out a number of proposals about United States economic relations with Third-World nations and raising a variety of concerns about the new Administration's approach to those relations. During the course of my government term, of course, I had access to literally thousands of classified documents. Many related

solely to economic conditions in one or more countries and had no justifiable basis for being classified. Indeed, as I am sure you know, overclassification is endemic throughout the federal government as it is such an easy way to avoid being called wrong in public. In all events, I do not believe I ever have misused classified information, but I can well imagine that some in this or another administration might think otherwise.

In fact, when my article on international economic development appeared, I received a thoughful letter from a staff member of the National Security Council criticising my criticisms of the current Administration and arguing why the Administration's approaches were justified. That sort of exchange is, of course, wholly proper. How tempting it would have been, however, if one in the National Security Council could not only criticize my criticisms, but stop or at least delay their publication.

Multiply those examples, if you would, Mr. Chairman, thousands of times over and you will begin to gain some sense of why the academic community in this country is so concerned about this matter. Part of our concern, of course, is parochial. We want to be able to serve from time to time in the federal

government, and to benefit from that experience in terms of our scholarly work. A far more important concern, however, is the crippling impact on good government that we believe would occur if critical analyses of the type I have suggested by example were to disappear in future years.

Am I overdramatizing? Is it absurd to suppose that a vast bureaucracy of censors would seek to silence former federal government employees? Would, as I predict, the most talented from our colleges and universities cease to serve in the federal government? Is all this concern exaggerated because it is 1984? I think not, and all those in academic life with whom I have discussed the matter think likewise.

IV

Mr. Chairman, when I left law school I had the great good fortune to work as law clerk for Judge Learned Hand, among this nation's greatest jurists. He was my mentor, one who urged me particularly to teach. One of his most powerful speeches was made over three decades ago, at the height of the McCarthy era. At this time, and in this context, an excerpt from that speech bears repetition. "The mutual confidence on which all else depends can be maintained only by an open mind and a brave reliance on free discussion. I do not say that these will

suffice; who knows but we may be on a slope which leads down to aboriginal savagery. But of this I am sure: if we are to escape, we must not yield a foot upon demanding a fair field and an honest race to all ideas."

Mr. Chairman, in my judgment and that of my colleagues, the Directive and the other proposed rules at issue today would hobble the race beyond measure. Thank you.

UNIVERSITY of PENNSYLVANIA
PHILADELPHIA 19104

Office of the Provost
102 College Hall CO

May 31, 1984

The Honorable Doug Walgren
House of Representatives
Chairman, Subcommittee on Science,
Research and Technology
Room 2319 Rayburn House Office Building
Washington, DC 20515

Dear Congressman Walgren:

Thank you for the opportunity, on behalf of the University of Pennsylvania, to testify before your Subcommittee last week on freedom of scientific communication.

As you requested, I enclose for the record a copy of the University's "Guidelines for the Conduct of Sponsored Research." These guidelines stipulate the policy of this University that open communication is integral to the research enterprise. As I mentioned in my testimony, consistent with our policy requiring full dissemination of research results, we do not accept research that requires access to classified information.

In addition, I am enclosing a discussion of the need for free exchange of scientific information that appeared in Almanac, the University's journal of record and opinion, in March of this year.

I hope that you and your colleagues found the hearings enlightening on the dangers of ill-advised research restrictions such as those we discussed. If I or my associates at the University of Pennsylvania can be of any further assistance in helping you address this important matter, please let me know.

Cordially,

Thomas Ehrlich

Enclosure

II . GUIDELINES FOR THE CONDUCT OF SPONSORED RESEARCH

The following guidelines were sent on April 3, 1981 by the President to all Vice-Presidents, Deans and Directors as the University's official policy on sponsored research. These guidelines replace those published in the 1977 Research Investigator's Handbook, referred to in the 1979 Handbook for Faculty and Administrators, Section F, page 93.

A. Roles and Responsibilities of the University and its Faculty

1. The University imposes no limitations on the freedom of the faculty in the choice of fields of inquiry or upon the media of public dissemination of the results obtained. It is the obligation of the faculty members to make freely available to their colleagues and to the public the significant results achieved in the course of their inquiries.

2. By providing financial support, physical facilities, and especially an intellectual environment conducive to research the University engenders scholarly inquiry by its faculty. In doing so the University recognizes its responsibility to the faculty to maintain a research environment in which unrestricted scholarship and freedom of inquiry may continue to thrive.

3. The University recognizes that its faculty consists of self-motivated scholars and scientists; their participation in scholarly or scientific controversies does not involve the University beyond its general support. Such support is predicated on the University's confidence that its essential functions are best accomplished by freely permitting capable scholars to follow the search for truth wherever it may lead.

B. Sponsored Research Projects

1. An interdependent relationship between the University and the research skills of its faculty becomes manifest whenever the University becomes involved as a corporate entity in the administration of research. In pursuing a policy of encouraging free inquiry the University affirms its reliance on its faculty in all matters of judgment concerning the intellectual merits of a project.

2. For its part as the beneficiary of gifts and as the recipient of grants and contracts, the University must reserve the right to accept only that support which does not in any way compromise the freedom of inquiry of its faculty, the integrity of its scholarship or its commitment to the policy of non-discrimination.

3. In its role as a degree-granting institution, the University views the substantial participation of graduate students in sponsored research as altogether appropriate to its educational mission.

4. The University administration does not distinguish between research activities which acquire new knowledge and research activities which apply existing knowledge. It leaves the decision of how to balance these two elements to the judgment of those who perform research and their academic supervisors.

C. Academic Evaluation of Sponsored Programs

1. Approval of proposals for grants, contracts and other cooperative agreements by the appropriate department Chairman and/or Dean is an indication that a favorable evaluation for academic merit has been made.

2. Where research programs lie outside the normal departmental or school structure, the Provost, or a designated member of the Provost's staff, has a special responsibility to assure that an appropriate academic review has been made.

D. Administrative Requirements for Sponsored Programs

The following seven conditions must govern any research agreement entered into by the University and a sponsor in order for a favorable evaluation to be made.

1. Open identification of sponsors and the actual sources of funding must be present in the agreement. Exception is made for anonymous sponsorship when in the judgment of the Provost such a condition is not harmful to the University nor to the integrity of the research and is essential for the award to be given.

2. Unrestricted dissemination of all findings and conclusions derived from the project must be an integral part of the agreement, except where the privacy of an individual is concerned. The University regards any infringement on complete access to research findings as detrimental to free inquiry. It therefore neither seeks nor accepts security clearance for itself or any administrative unit. The decision whether to seek clearance is an individual one to be made by each faculty member according to his or her judgment. Such decision will not be influenced or judged in any way by the University and must be made in each instance on the basis that the benefits of clearance balance its academic shortcomings. Exception may be granted by the Provost for privileged information but only in the form of a delay in the release of such information. The delay will only on rare occasions exceed three months.

3. The resources or data sources on which research is wholly dependent must be free of control by the sponsor. The University views such control as incompatible with free inquiry and encourages acceptance of this condition only when no alternative source exists. Exception may be granted by the Provost for projects which are conducted abroad and subject to the legal restraints of foreign governments and their agencies.

4. No conditions may be attached to the gift, grant or contract that would in any way jeopardize the University's commitment to the principle of non-discrimination on the basis of race, color, sex, sexual or affectional preference, age, religion, national or ethnic origin or handicap.

5. Academic appointments made with the support of gifts, grants, or contracts shall be made only in accord with established University procedures. A sponsor shall not ordinarily participate in the selection of persons to work on a project, and individuals employed by the University shall not be excluded by a sponsor from participation in a project for any reason other than when necessary because of insufficient competence or when required to protect privileged information.

6. No financial obligations by the University in the present or any time in the future can be implied other than those stated in the contract. When uncertainty exists in his judgment, the Provost or a designated member of the Provost's staff shall consult with appropriate officers of the University to assure that this condition is met prior to the final approval of the agreement.

7. The University relies primarily on the discretion of its faculty to limit the commercial aspects of research sponsorship, such as advertising and publicity. Contracts must not allow the use of the University's name for commercial purposes unless such use has been specifically approved by the President of the University. Agreements must not permit the names of University investigators to be exploited for advertising purposes or permit reprint distribution to be made part of a publicity campaign.

E. Administrative Review of Sponsored Programs

1. Approval by the Provost or a designated member of the Provost's staff indicates the the evaluation of compliance with the University's administrative requirements has been favorable.

2. Grants and contracts which in the judgment of the Provost have features which pose potential embarrassment to the University or raise serious non-technical questions of compliance with this policy will require further review. This review is to be accomplished by the Council Committee on Research.

3. Concurrently with the call for consultation, notice of the project shall appear in Almanac.

4. Failure to conform to the Guidelines is expected only on rare occasions marked by special circumstances, such as the exceptional public need of a national, regional or local emergency. On these occasions it is required that the President of the University in consultation with appropriate faculty shall give approval to such action.

DISCUSSION

Academic Issues in Federal Policy

Below and in the following three pages, members of the University community discuss recently proposed—and in part temporarily suspended—federal directives, and their potential impact on research and scholarship. Two members of AAUP committees, Professors Lowery and Mendelson, give an overview starting on page 4. On pages 5-6, Provost Thomas Ehrlich provides for the record the testimony he prepared for the Governmental Affairs Committee of the U.S. Senate.

To the University Community

We are deeply concerned with proposed changes in Federal policy respecting freedom of communication. Those changes, if implemented, would impede the conduct of research and the free flow of information that is vital to the academic enterprise at Penn and other universities.

The principle that students, faculty, and staff may communicate freely and openly guides this University. This tenet not only is fundamental to a democratic society, it is essential to the pursuit and advancement of knowledge. Any threat to freedom of communication must be viewed with alarm.

Suggested changes in Federal policy could result in restraints on the free exchange of research findings relating to scientific and technological information, through export controls and other measures. Such policies, if implemented, would have precisely the opposite effect they are intended to produce. By restricting the communication of research findings, the scientific and technological research base we wish to expand is likely, instead, to contract.

We endorse the statement by the Committee on Research and will communicate this position forcefully to our elected representatives in Washington, to Administration officials, and to appropriate scientific and educational associations.

Sheldon Hackney

Thomas Ehrlich

Freedom of Communication in Research

A Statement of the Committee on Research

1. This Committee recognizes that free communication of information is essential for academic pursuits., as well as for the health of science and technology of the Nation. We therefore reiterate the long-held University of Pennsylvania position that research conducted at the University or under University auspices concern only projects which do not contractually infringe on the University community's right to freely communicate research results.
2. The Committee objects strenuously to federal efforts to impose unilaterally ex post facto restraints on communication and publication of results of research projects. We urge:
   a) the University to defend by all means at its disposal the inviolability of contractual commitments;
   b) the Federal Government to observe due process and not to seek to impose such restraints except in the gravest matters of national security and then only after full consultation with the University and the principal investigator.
3. With increasing apprehension the Committee has witnessed the gradual erosion of scholarly exchanges between the USA and other countries. Exchanges of scholars represent another facet of free flow of information on which the health of academic pursuits depends. The Committee therefore urges the Federal Government to encourage and facilitate such scholarly exchanges by implementation of pertinent recommendations of the Report of the National Academy of Science Panel on Scientific Communication and National Security (the Corson report) released on September 30, 1982. It is recommended that the adopted resolution be forwarded by the President of the University:
   a) for publication in *Almanac*, in order to inform the University community;
   b) to Dr. George A. Keyworth, II, Science Advisor to President Reagan;
   c) to the Honorable D. Walgren, Chairman, House Subcommittee of Science, Research and Technology;
   d) to the National Academy of Sciences, Association of American Universities, American Association of University Professors, the American Association for the Advancement of Science, and other relevant organizations.

Chair: *Helen Davies (microbiology in Med.)*
Faculty:
Morris Hamburg (statistics)
Robert A. Kraft (religious studies)
Alfred Mann (physics)
Janet Memminger (nursing)
Ezra Miller (finance)
Gary Saul Morson (Slavic languages)
Janet Pack (public and urban policy)
Trevor Penning (pharmacology)
Eric Weinberg (biology)
Jay Zemel (electrical engineering)
Students:
Harold Cooper (Col '85)
Bruce Rollman (Col '84)
Earle Taylor (Gr Fac)
Prashant Vankudre (Gr Fac)
Ex officio:
Barry Cooperman (vice provost for research)
Anthony Merritt (director, Research Administration)
Consultant:
Arnost Kleinzeller (physiology in Med.)

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The views of two members of the University who are serving on national AAUP committees.

Freedom: Under Attack on Three Levels

Freedom of speech comes close to being an absolute value. Without it all other values are in jeopardy and their defense impaired. Not only is academic freedom an aspect of freedom of speech, but any impairment of it is an impairment of the freedom of speech. That freedom is not preserved by not exercising it. Any and all attempts to erode it must be resisted vigorously.

Anyone reviewing the history of the Third Reich should be impressed with the gradualness with which anti-free speech measures were introduced so that no step, in comparison with those that had already been taken, triggered significant resistance. If academic freedom is destroyed, it is likely to be destroyed gradually rather than in one fell swoop. Each curtailment will be accompanied with a plausible rationale until there is little or nothing to be preserved. The old observation that the price of liberty is eternal vigilance is an enduring truth, not merely a cliché.

Perhaps to no institution is the freedom of speech more important than to institutions of higher education. As a consequence, some of the measures taken by the federal government warrant great concern in the academic community—and very vigorous resistance.

An attack by the federal government on academic freedom and freedom of speech has taken place on three levels. The attempt to require all federal employees and officeholders to clear subsequent writing for the rest of their lives is possibly one of the most pernicious and misguided gag rules that has ever been conceived in a democracy. The second level is embedded in Executive Order 12356, which expands the power of government officials to classify material. The third level is the utilization of export control laws and visa regulations to impede the flow of scientific and technological information.

It must not be forgotten that while academic freedom is very important to the individual professor, the primary purpose of that freedom is not the well-being of the professor, but the advancement of general welfare. Not only does evolutionary, in contrast with revolutionary, change require open discussion, but the growth of our intellectual capital requires freedom of thought and communication. That growth is stunted if researchers are walled in and denied the ability to share the results of investigations with colleagues at home and abroad. National pride and the penchant for secrecy should not blind us to the fact that we are not the most advanced country in every aspect of science and technology.

The central concern of the American Association of University Professors (AAUP) has been the preservation of academic freedom. The Association has alerted the academic community and spoken out against these infringements in "Federal Restrictions on Research: Academic Freedom and National Security" (*Academe*, pp. 18a-20a, September—October, 1982), "The Enlargement of the Classification System" (*Academe*, pp. 9a-14a, January-February, 1983), and "Government Censorship and Academic Freedom" (*Academe*, pp. 15a-17a, November—December, 1983). It is gratifying to know that the administration of this university has also taken a firm stand. Indeed, it is my understanding that Provost Ehrlich is addressing the issue of gagging government employees in this issue of *Almanac*. Although we have not read his piece, we are confident that it is as vigorous a condemnation of that aspect of censorship as we are trying to make this discussion of the other two aspects of government censorship.

The academic community must not labor under the illusion that government measures affect only government employees, ex-government employees, and those researchers who have been financed with government grants. The measures also affect the publication of the research results of any academician, whether financed by government or not, "which contains information the unauthorized disclosure of which reasonably could be expected to cause damage to the national security," as evaluated by bureaucrats and political appointees ("The Enlargement . . .," p. 10a). Such papers are subject to being classified as "confidential."

The publication of information that would give an enemy "significant near term military advantage" can reasonably be controlled and has been subject to classification for a considerable period of time. However, in contrast with the predecessor orders, Executive Order 12356 no longer seeks "to preserve the public's interest in the free circulation of knowledge by limiting classification authority, by defining precisely the purpose and limits of classification, and by providing procedures for declassification." It no longer requires that damage to national security be identifiable. It resolves doubt in favor of classification. It provides for both indefinite classification and reclassification of information already in the public domain. Perhaps most important of all, it provides for the classification of "nonclassified research developed by scientific investigators outside the government." ("The Enlargement . . .," p. 12a).

It should be clear that, given the "protect-the-rear" mentality of bureaucrats and the superzealousness of political appointees, all doubts will be resolved in favor of classification, pending a final determination within thirty days in case of doubt notwithstanding.

Given the need to classify material of direct military significance, there is much to be said for a carefully circumscribed system which invokes classification before the research is done. Given the clear stand of most major universities, that they will not be parties to secret research, the authority to classify academic research results that were born unclassified is tantamount to a breach of contract and undermines the ability of universities to make informed decisions about their research.

When classification imperils the freedom it is designed to protect, it is counterproductive. Aside from undermining the ability of universities to make informed decisions about their research, the environment created by the regulations:

- Magnifies the hazards to academic freedom.
- Threatens the capacity of scholarship at the cutting edge of knowledge.
- Inhibits scholars and institutions from undertaking important research that is potentially classifiable or making the long-term intellectual investment that makes that research possible.
- Fosters duplication of research effort.
- Inhibits sharing of research with colleagues and robs the researchers of the enriching comments of their colleagues at home and abroad.

Lest the academic community labor under the illusion that these fears are "academic," it is well to note that:

- The American Vacuum Society was forced by the Department of Commerce to withdraw invitations to East European scientists to attend an international conference on magnetic bubble devices.
- A Soviet postdoctoral researcher at an American university was not allowed to attend a conference at San Diego where a paper he

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had co-authored had been submitted.

• The University of Minnesota and Stanford University were asked by the Department of State to deny access to *unclassified* information to resident visiting scholars from China and the Soviet Union respectively. When Stanford refused, the Soviet scientist was denied entry into the country.

It is gratifying to see that the Council Committee on Research is alert to and the University administration is vigorously opposing these misguided attempts of the federal government to gag faculties. There appears to be little that most of the faculty can do now, but all faculty members should be ready, when modifications of the relevant laws and regulations are proposed, to make clear to the appropriate parties the importance that we attach, and think should be attached, to academic freedom—and the repugnance with which we view measures which impair it.

A special responsibility is borne by the members of the faculty engaged in government funded research. They must be on guard against over-zealous government negotiators and refrain from accepting restrictive clauses that infringe upon academic freedom and may set precedents for increasingly restrictive clauses.

The authors are, respectively, the campus legislative liaison for the AAUP (national), and member of the AAUP (national) Committee on Government Relations. The opinions expressed herein are their own. They would, however, appreciate hearing from the faculty relevant concerns and experiences.

—Barbara J. Lowery,
Associate Professor of Nursing

—Morris Mendelson,
Professor of Finance

The Provost's statement prepared for the Governmental Affairs Committee of the U.S. Senate.

More Than a Chill . . . No Less Than a Deep Freeze

Mr. Chairman and members of the Committee:

I am pleased to appear before you, though deeply troubled by the Presidential Directive and accompanying regulations that occasion this hearing.

My appearance is on behalf of the University of Pennsylvania, where I serve as Provost and Professor of Law. That University includes about 1800 members of the standing faculty, and more than that number of associated faculty. All of them are potentially affected by the directive. Its possible impact on the 19,000 undergraduate and graduate students at the University is indirect, but no less real.

I also appear on behalf of three of the most important associations that represent institutions of higher education throughout the country. They are the Association of American Universities, which includes fifty-two leading research universities throughout the country, the American Council on Education, which represents 1600 colleges and universities of every type and in every state throughout the country, and the National Association of State Universities and Land Grant colleges. In total, these organizations involve institutions with well over 250,000 faculty members and eight million students.

As you know, Mr. Chairman, those of us in academic life put a high premium on disagreement. Virtually the only absolute that we hold in common is that there are no absolutes, and that every issue is open to discussion, debate, and—most important—disagreement. It is profoundly significant, therefore, that I know of no individual in academic life who supports the Presidential Directive that is the subject of these hearings. Virtually alone among important public issues in recent times, the reaction of those in academia to the Presidential Directive is completely uniform and completely negative. I cannot overstate the dangers we see in the approach it adopts.

As you know, in April 1982, the Administration issued Executive Order 12356, establishing new standards for classifying information. That Executive Order, among many other troublesome provisions, eliminated the requirement that officials consider the public interest in judging how to classify material or whether to release it, and authorized officials to classify documents without basing their decisions on any "identifiable" potential damage to national security.

Against the background of that Executive Order, the President issued National Security Decision Directive 84, entitled "safeguarding National Security Information" on March 11, 1983. That Directive contains two key provisions that trigger our deep concern.

First, paragraph 1.b. of the Directive requires that "all persons with authorized access to Sensitive Compartmented Information (SCI) shall be required to sign a non-disclosure agreement as a condition of access to SCI and other classified information. All such agreements must include a provision for pre-publication review to assure deletion of SCI and other classified information."

Paragraph 1.a. of the Directive requires "all persons with authorized access to classified information . . . to sign a nondisclosure agreement as a condition of access." Although this paragraph does not actually require pre-publication review as does paragraph 1.b., the remedies for breach of each paragraph are exactly the same and the implementing regulations make plain that all signatories to paragraph 1.a. would be justified in acting as though a pre-publication review requirement applied to it as well. Although my subsequent comments will focus exclusively on paragraph 1.b., therefore, the concerns I express apply to the Classified Information Disclosure Agreement as well.

Under the SCI Nondisclosure Agreement Form to be required of government employees, and presumably others with access to classified information under government contracts, pre-publication review is required of "all materials, including works of fiction . . . prepared for public disclosure, which contain or purport to contain: (a) any SCI, any description of activities that produce or relate to SCI, or any information derived from SCI; (b) any classified information from intelligence reports or estimates; or (c) any information concerning intelligence activities, sources or methods."

It is hard to imagine a broader definition of materials that must be screened by unnamed and unidentified government officials. As the Justice Department's implementing regulations make clear, coverage is not limited to classified information, but includes any information that is "required to be considered for classification pursuant to Executive Order 12356, Section 1.3(a)(4)." Further, even if no classified or classifiable information is actually contained in a proposed publication, pre-publication review is still required in an incredibly broad spectrum of circumstances. Even oral statements—in a classroom or otherwise—are covered if they "may contain SCI or other classified information." A caveat is included concerning "material that consists solely of personal views, opinions or judgments. . . ." It is immediately overridden, however, by this exception to the caveat: "of course, in some circumstances the expression of 'opinion' may imply facts and thus be of such a character as to require prior review."

I could go on in more detail, but I know the Committee has received extensive analyses of the Directive from others as well. As a lawyer and law professor, I could also join with those raising the most

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fundamental questions about the constitutionality of the provisions I have just cited. Others, however, more expert than I in constitutional law, have given compelling testimony on that score.

My role today rather is to emphasize, in the strongest possible terms, why this Directive and its pre-publication requirement will have disastrous effects on the quality of our government in terms of those who enter and leave public service from academic life. Those consequences can be clustered in two broad categories.

First, the Federal Government depends on expertise from a wide range of different backgrounds, including those in academia. Indeed, it is a distinctive virtue of our Federal Government that one in academic life may be called to serve for a period of years and then return to her or his college or university. Those faculty members bring expertise and insights, analytic powers and experience, that are a unique resource. Colleges and universities are not the sole repository of talent, but they are an enormously important one.

A main reason why women and men from academic life take time out to serve in the Federal Government is, of course, because they feel an obligation to do so. It is also true, however, that work in the Federal Government provides an opportunity to experience problems and to test ideas on a first-hand basis. Those of us in academic life are often accused of living in an ivory tower, and sometimes not without reason. Federal Government service offers a chance to gain a first-hand perspective on matters that a faculty member has been analyzing from afar. It is hardly surprising, therefore, that a key inducement of government service is that the first-hand perspectives, once gained, will be then used—in scholarly publications, in classroom lectures, and in other ways as well.

Under the Presidential Directive, far more than simply a chill would be cast over that inducement. The result would be no less than a deep freeze. Who could be sure that any particular piece of prose would not be found by some unidentified bureaucrat to contain some information that, if not classified, should be classified? I can think of no single step that would be more likely to deter the best of those in academic life from service in the Federal Government than this one.

There is a second, and perhaps even more serious concern. I believe with some passion that good government depends on good criticism. Those who have served in the Federal Government from academic life, and have then returned to that life, are often in the best position to provide that criticism. This is not, of course, a matter of partisan politics. Over the last decades, thousands of women and men from our colleges and universities have served in Republican and Democratic administrations. When they return to their academic careers, the quality of our Federal Government was immeasurably benefitted by their analyses of their predecessors and successors.

Under the Presidential Directive, the risk is grave that these benefits would be seriously impaired. I cannot quantify the danger, but I can assure you it is clear and present.

If I may, Mr. Chairman, let me use my own career as a case in point. During 1962 to 1965, I had the privilege of serving in the Department of State, as special assistant first to the Legal Advisor and then to the Under Secretary of State. Subsequently, I became professor of law and then dean at Stanford University. I taught and wrote particularly about international law, and believe my academic work was immeasurably strengthened by my years in the State Department.

In preparing for this testimony, I reviewed the books and articles that I wrote during my years at Stanford. Some were extremely critical of actions and inactions by the Johnson Administration, and by subsequent Administrations as well. Would those writings have withstood the scrutiny of the pre-publication clearance required by the Presidential Directive? I do not know.

In working with Under Secretary George W. Ball, I had access to a great deal of classified information about United States' involvement in Viet Nam. In the years after I went to Stanford in 1965, I spoke out against United States military involvement in Viet Nam. It does not take much imagination to craft an argument that my "opinions" were based on "facts"—using the words of the Justice Department interpretations—to a degree that would have made it very tempting for those in the Johnson and then the Nixon Administration to seek my silence.

I wrote a book about the international legal aspects of the crises in Cyprus from 1964 to 1974. My initial knowledge of the problems on that unhappy island came during my State Department years. Subsequently, while I was teaching and writing at Stanford, American policies changed concerning Greece, Turkey, and Cyprus a good many times. It does not seem to me paranoiac to suggest that some might have found my book inappropriate for publication.

More recently, I served as the first Director of the International Development Cooperation Agency, with responsibilities for United States policies concerning international economic development. Soon after I left that position, I wrote an article spelling out a number of proposals about United States economic relations with Third-World nations and raising a variety of concerns about the new Administration's approach to those relations. During the course of my government term, of course, I had access to literally thousands of classified documents. Many related solely to economic conditions in one or more countries and had no justifiable basis for being classified. Indeed, as I am sure you know, overclassification is endemic throughout the Federal Government as it is such an easy way to avoid being called wrong in public. In all events, I do not believe I ever have misused classified information, but I can well imagine that some in this or another administration might think otherwise.

In fact, when my article on international economic development appeared, I received a thoughtful letter from a staff member of the National Security Council criticising my criticisms of the current Administration and arguing why the Administration's approaches were justified. That sort of exchange is, of course, wholly proper. How tempting it would have been, however, if one in the National Security Council could not only criticize my criticisms, but stop or at least delay their publication.

Multiply those examples, if you would, Mr. Chairman, thousands of times over and you will begin to gain some sense of why the academic community in this country is so concerned about this matter. Part of our concern, of course, is parochial. We want to be able to serve from time to time in the Federal Government, and to benefit from that experience in terms of our scholarly work. A far more important concern, however, is the crippling impact on good government that we believe would occur if critical analyses of the type I have suggested by example were to disappear in future years.

Am I overdramatizing? Is it absurd to suppose that a vast bureaucracy of censors would seek to silence former Federal Government employees? Would, as I predict, the most talented from our colleges and universities cease to serve in the Federal Government? Is all this concern exaggerated because it *is* 1984? I think not, and all those in academic life with whom I have discussed the matter think likewise.

Mr. Chairman, when I left law school I had the great good fortune to work as law clerk for Judge Learned Hand, among this nation's greatest jurists. He was my mentor, one who urged me particularly to teach. One of his most powerful speeches was made over three decades ago, at the height of the McCarthy era. At this time and in this context, an excerpt from that speech bears repetition. "The mutual confidence on which all else depends can be maintained only by an open mind and a brave reliance on free discussion. I do not say that these will suffice; who knows but we may be on a slope which leads down to aboriginal savagery. But of this I am sure: if we are to escape, we must not yield a foot upon demanding a fair field and an honest race to all ideas."

Mr. Chairman, in my judgment and that of my colleagues, this directive would hobble the race beyond measure. Thank you.

— *Thomas Ehrlich*

Mr. WALGREN. Thank you very much, Mr. Ehrlich.

I really do want to salute the testimony that the three of you have given. I would hope that, given here and in other forums, that that will form a very strong underlying reference point for anybody who is active in this area, because it is an area that clearly is a slippery slope that could sweep well beyond constructive application.

Let me ask in general—and perhaps I could best direct this to Dr. Corson. The views that have been expressed by this panel, how confined are they to universities, per se? I'm fishing around in the area, that it is my understanding that people have looked for documentable transgressions or adverse results in this area of transfer, and at least have not found significant ones with respect to universities.

Could you comment on that, and then the question then comes, should the universities be treated very differently than other centers of research? Obviously they're treated differently than in-house Government employees, but what about Government contracted labs and what about the Silicone Valley interests that Mr. Zschau spoke to earlier?

Dr. CORSON. Let me say first of all that in the activities of my panel 2 years ago, we had access to intelligence information at the highest level. We had complete cooperation from the technology transfer intelligence committee, from the various agencies, DIA, CIA, and so forth. We could find no documentable cases of transfer through the open literature or through other kinds of scientific communication.

These are hard to document. It is difficult. I believe I am on sound ground in saying that no particular progress has been made in the last 2 years in developing ways that could document these more effectively. There is no evidence.

I do not believe universities should be treated differently from anybody else. If they are different, it is because they are involved in the educational process and it is in the development of young people that there is a particular concern. There are other aspects of the problem that enter whenever one starts talking about industrial research—and I am sure Dr. Schmitt will illuminate those problems and those considerations. There are proprietary interests that get into consideration. But the same kind of open publication bearing on scientific research as applied to industrial research laboratories, once their proprietary interests have been taken care of, is applied to anybody else.

Let me give you an example. Bell Telephone Laboratories developed a transistor in the late 1940's. That technology was made available to everybody. September 1951, Bell Laboratories held a week-long symposium in New York, in which they laid out the benefits and the technology—everybody can see the benefits—laid out the details of the science and technology involved for everybody to see, in open fashion, and the benefit this country reaped from that is enormous. It gave us a tremendous leap ahead in our international competition in electronics.

I don't know that that example is relevant to the situation that prevails today, but still, it gives one pause for thought in thinking about it.

Mr. WALGREN. But you indicate there is no evidence whatsoever with respect to university transfer?

Dr. CORSON. Let's define what we're talking about. Any time we publish something that's a new advance in science, as President Gray pointed out, we are moving ahead. We are giving an advantage to somebody else. That is undeniable. What we are talking about here is using those products of basic research to influence the production of military equipment or systems by an adversary within one so-called production cycle, which may mean 10 years, 12 years—some anecdotal evidence that I've heard that the Soviet Union's production cycle is shorter than ours; I don't know whether that's reliable or not. But to look at a military advance, to try to tie that to a publication, or to a report, or to public information about a scientific development in the recent past, there is no example that has been presented to me.

Mr. WALGREN. I think that ought to—that that statement should stand strongly on its own two feet.

Remembering that we are talking about areas of nonclassified effort, I would like to ask, although it perhaps is implicit in your testimonies, but each of your testimony highlights the dangers of restrictions in this area. The question comes, is this an area, recognizing that we are not in the classified area, and we are not infringing on the power of these individuals to classify certain areas of information, so there is no argument that recognizable effort and its fruits could not be segregated and walled off.

Recognizing that we're talking about the nonclassified area, do you really feel that this is an area of balance, where we are balancing substantial interests in restrictions against substantial interests in progress? Now, obviously, Dr. Corson, your committee did balance. You found gray areas. You asked for tall fences around specific focuses. And there are words of balance in Dr. Gray's presentation and some in Mr. Ehrlich's statement. But just listening to it, should we be balancing in this area? Are the things that we give up so significant that, given the power to classify, that that's where the responsibility to protection the national interest should be exercised?

Can I ask that of all panelists, if I could?

Dr. CORSON. My own view is stated in my testimony. I believed, and I believed with my panel 2 years ago, that there are very narrow areas where balance requires a degree of restriction, a minimal degree of restriction. Otherwise, I think that national interest is served by having the unclassified area completely open, and it is the power to classify that protects the national security interest.

Mr. WALGREN. Dr. Gray.

Dr. GRAY. Mr. Chairman, I am essentially in agreement with the position which Dr. Corson just defined. I think that there are areas where the question of a choice if, indeed, that is a choice, the choice between complete openness and classification, which removes—well, I think in most cases, would have the effect of removing that work from the purview of the university—where that choice, in the light of all the national interests, and in the light of the nature of research in that field, is very difficult to make.

The example which Dr. Corson mentioned in his testimony, which I believe I mentioned in mine, is in the area of microelectronics. This is a field in which research is conducted across the full spectrum of activities, ranging from basic research to highly applications oriented development. It is a field which has enormous interests and implications for the universities, who must come to terms with this field if they're going to educate in a satisfactory manner future generations of engineers; to the Government with respect to military applications; and, quite obviously, to American industry, with respect to a whole range of products, systems, devices, which are elements of international commerce.

I think in that area it would not be in the national interest to take the position that the potential sensitivity of some of those results require that the work be classified. I believe that that would have serious consequences both for the quality and extent of work that was done in universities in that area, and most importantly, would have very negative consequences for the education, particularly for future generations of engineers, whose training and education must bear, must include those areas.

For that reason, it seems to me that it is necessary to look at what the Corson panel referred to as the gray areas, those areas of carefully defined character which may require special treatment within institutions where such work is performed. I believe that is a judgment about sensitivity which would find substantial support in the university community.

Mr. EHRLICH. Mr. Chairman, I, too, as the only nonscientist on the panel, am prepared to accept the judgment which essentially is "never say never," that yes; there can be those areas. The point I would stress is that we do, by not classifying, but nonetheless imposing some restrictions, pay a price for those. It is very important to understand that price and articulate it as clearly as possible and measure it against the potential concerns that Dr. Gray just described. But in that there is an area, and insofar as I can tell, it is quite a small one, and the importance of defining it and avoiding creeping grayness is all the more underscored.

Mr. WALGREN. Now, the creeping grayness problem is one that certainly strikes me, and I am trying to remember anecdotes of creeping grayness, of what was classified by people. We know that in the bureaucracy it is just such a less risk course to take to classify something than not, that it just always is classified as a matter of routine.

So then the question comes: What sensitivity have you people felt on the part of the Government in your interactions with the Government to this problem. As I read this testimony, I hear some very absolute negatives to going down this road stated, and then in the end a willingness to either not say never or work in this area of grayness with a caveat that it might not work out.

What has been the response of the other side? As I understand it, Dr. Corson, the National Academy of Sciences has interacted with the Government, particularly with the executive branch, and I would be curious as to your assessment of their sensitivity in this area. Dr. Gray, I understand you wrote a letter that was published in one of the papers to the Department of Defense, focused on the

prepublication restraint. We certainly would be curious as to your assessment of their response.

I would like to ask that question generally to all of you. What sensitivities do you sense on the other side of this question?

Dr. CORSON. I have had continuing informal discussions with people in the Department of Defense, particularly those who are here today, Dr. Martin and Dr. Young. I followed the developments as they have pursued them. My own view is that the proposals that have been developed have been done with a great deal of concern about the problem, a great deal of effort applied to it, and with the best intent in the world to arrive at a balanced system.

My own judgment is that we are going toward an unbalanced system if all those provisions are finally put into place, and that applies to the export control regulations as well. It is going too far, and I think too many things are being swept up into the gray area. I would like more effort spent on defining clearly what falls within the gray definition.

Dr. GRAY. Mr. Chairman, the sensitivity to these issues within the university community I think is influenced substantially by the difficulty we have had within universities in understanding what the definition of the gray areas would be. The Corson panel set out a set of criteria which helped to define, in their judgment, how those areas should be construed. But in the discussions that I or my colleagues have had with persons in the Department of Defense in particular around these issues, there has not emerged to my knowledge a definition of what one means by "sensitive areas," as they have been called, which enables one to understand the possible scope of those areas and to form some impression of the kind of impact there would be within the university research community if the regulations, which at one point were being discussed in draft form, were, indeed, applied to sensitive areas.

I think one of the reasons that folks in universities are sensitive to these issues and have expressed concern about these issues is precisely the problem of forming some judgment about how broadly the areas called sensitive would be defined. It has been very difficult, for me, at least, and my colleagues, to get any clear sense of how broad that would be. Those areas have not been defined in terms which relate to particularly the Corson report, or enable one to come to some independent judgment about what would be called sensitive.

With respect to the letter to which you referred, there has been no response. It may be too soon to expect one, sir.

Mr. EHRLICH. Insofar as I can tell, Mr. Chairman, the reaction is one might expect—uneven. There certainly are a great many, in each of the agencies and departments to which we referred, who are very understanding of the kinds of problems and sensitive to them. If there is an endemic concern, it relates to the one you just mentioned, of overclassification. It has its counterpart here in a concern about defining "sensitivity," defining a term on the theory that maybe we're going to let something get away, so we had better be vague and ambiguous on the grounds that will keep it all in.

The sadness of that approach, of course, is that it is undercutting the very kind of research that all of us—and we are absolutely

united in this, in Government and out—in wanting to promote basic research that will further the national interest.

Mr. WALGREN. Who would be the ultimate decisionmaker under various ways of going forward? I'm remembering the Corson report, some thought being that the publication side of it would be left to the university to decide, after—perhaps I'm wrong about this. But the question is, Is it anticipated that the Government have veto power, that they decide this is an area, and it is our interpretation of the area and you shall not, versus some kind of a dialog where somebody other than a person who might be very ready to overrestrict have the final say?

Dr. CORSON. The veto power by a Government agency is a critical issue in the discussion of how gray areas should be dealt with at the present time, and we'll probably hear more about that before the testimony is over today. Universities, by and large, will not accept veto power.

Nonetheless, the sponsoring agencies are a very strong negotiator in these discussions. I think almost all universities—never say "all" I think is probably good advice. But most universities are quite prepared to discuss problems with contracting officers, where the contracting officer has had an opportunity to review manuscripts and believes there is some problem.

There is a good example in the cryptographic research area, where there is now an informal agreement between the mathematicians working in this area and the National Security Agency, where not all but I think most people, investigators working in this area submit their manuscripts for review prior to publication, within discussion of whether something should be published or not be published.

There have been several hundred of those manuscripts submitted for review now. There has been discussion about a number. I believe there have been modifications of the manuscripts in a few cases. The last I heard, two manuscripts had been withdrawn after those. That is a totally voluntary cooperation which works because it's a small field. Everyone working in it knows everyone else. The NSA people know the mathematicians in universities, and the university people know the NSA experts. I think it won't work in other fields, but it is evidence that there is a willingness to discuss and on that basis decide whether some manuscript should be modified.

Universities will insist on keeping the final publication authority to themselves——

Mr. WALGREN. What's the administration's position at this point on that question?

Dr. CORSON. That is changing so rapidly that I don't think I can state that.

Mr. EHRLICH. Mr. Chairman, we are eager to hear that position.

If I might excuse myself, if I don't, in about 2 minutes I will have several hundred faculty members mad, not just on this issue but——

Mr. WALGREN. All right. Let me ask one other question then before you go.

That is, can you describe whether your university has a policy internally developed with respect to trying to prevent this kind of

transfer and how to react to a Government request? You don't do classified research——

Mr. EHRLICH. Correct.

Mr. WALGREN. Does the university have a policy in this area that has been brought out?

Mr. EHRLICH. We do have a set of policies in terms of the kinds of interactions that were just described by Dr. Corson. What I would be delighted to do is provide that for the record, the material that we have. It might be helpful for you.

Mr. WALGREN. Thank you very much. I appreciate your time constraint and thank you for coming.

Mr. EHRLICH. Thank you.

Mr. WALGREN. Let me give Dr. Gray an opportunity to respond in the same area.

Dr. GRAY. Thank you, Mr. Chairman. I'll try and be very brief.

With respect to the question of policies in this matter, we, indeed, have developed in these last 2, 3, 4 years two statements that bear on this question. One was the result of a study of these matters by a faculty committee; the other, appropriately, was the result of a similar study by a committee of trustees.

Let me say, simply by way of summary, that the policies I believe are, in their general nature, consistent with the recommendations made by the Corson panel. That is, they say that under extraordinary circumstances, in a limited range of activities, it may be appropriate for the institution to undertake limitations of access and some constraints on publication because of the nature of the work.

Neither of those policies spells it out in as much detail as the Corson report did, but I believe that those policy statements are consistent with the Corson report.

Finally, if I may, I would like to say one thing about the process of discussion between the universities and the Department of Defense on these questions. That discussion has been conducted in a group known as the DOD/University Forum. And while there has been, as I indicated earlier, difficulty in understanding each other around the question of what shall be called sensitive, I think there has been general agreement between the universities and the Department of Defense that the proper place to address the question of what restrictions, if any, should be applied is at the level of the contract language, the language which would specify and be agreed on, specify the terms of reference of the work and be agreed on between the sponsor, presumably the DOD sponsor, and the university. Addressing the problem at that level, the level of contract language, strikes I think all of us in the university community as the right place to address it, in the sense that it is there that the university has a chance to look it over and say this fits or it doesn't fit.

Leaving it open at the contract level and subjecting results in some manner to an ad hoc review after the work is done is much more difficult for the university community to deal with.

Mr. WALGREN. And I gather you have some experience with that in the university's relationship with other laboratories, Lincoln Laboratories, is it, or Draper Laboratories, where there are certain

relationships that the university has with laboratories that may be more involved with sensitive research than the university itself?

Dr. GRAY. Yes. MIT does operate, as an integral part of the institution, the Lincoln Laboratory, which is a major Department of Defense contractor doing research and development for all services. And much of the work done there is classified in nature.

Mr. WALGREN. Does MIT do classified research?

Dr. GRAY. Not on the campus, no, sir.

Mr. WALGREN. And that has been a longstanding policy?

Dr. GRAY. That has been a policy in place for, somewhere between 15 and 20 years.

Mr. WALGREN. I see.

Dr. GRAY. We did do research on the campus during the Second World War, in the decade or decade and a half following the end of the Second World War.

Mr. WALGREN. We have 3 minutes and then I'll respond to that vote, and then we'll come back.

I wanted to ask Dr. Corson, you mentioned—I think it was in your testimony, where you indicated that if the universities are not to have access to graduate students as students and as teachers of the more advanced levels of education, that something very bad was going to happen. I wish I could put my hands on that. "If that flow is cut off, for whatever reason, we are in trouble" is your words.

Would this argue for a much greater emphasis in our educational system, to try to get Americans into those positions?

Dr. CORSON. That's an important question. The reasons why we have fewer American citizens going into some fields, particularly, say, the engineering AFC program is an important question. There are many reasons for it probably. But it will take a long time to solve that problem, and certainly in the meantime we are dependent heavily on foreign nationals.

I want to make clear that foreign nationals are totally competent people.

Mr. WALGREN. But it is true that we have developed a situation where for some reason our own nationals are not going on through the educational process to that degree and——

Dr. CORSON. They intend to take a professional degree at the graduate level and by and large go into industry. For many reasons, the universities haven't attracted them as much in the past decades.

Mr. WALGREN. Let me express my appreciation and that of the committee for your contribution to this subject. We look forward to exchanging ideas with you as time goes on, and we certainly want to maintain the committee's interest in this.

I would to ask one more specific question. What would you have the Congress do about this?

Dr. CORSON. I would certainly have the Congress pay very careful attention to the provisions of the Export Administration Act, and the regulations that go with that act, in its new form when it is enacted. Those are going to be, as Mr. Ehrlich said, very important regulations.

Dr. GRAY. I would agree with that.

Mr. WALGREN. Any other specific—There have been no bills, to the best of my knowledge, introduced on this subject yet. Well, we do appreciate very much your being a resource to the committee. Thank you.

Dr. CORSON. Thank you, Mr. Chairman.

Mr. WALGREN. We will recess for 10 minutes and then we'll proceed with the second panel.

[Whereupon, the subcommittees were in recess.]

Mr. WALGREN. Let me call us back to order and introduce the second panel, made up of Dr. Roland Schmitt, who is the senior vice president for corporate research and development at General Electric, and Dr. Leslie Glick, the chairman and chief operating officer of Genex Corp. We appreciate your making yourself available to the committee and apologize for the time and the interruptions.

Your written statements will be made part of the record, and please feel free to summarize and focus on the important points that you would like to make in whatever way you feel most effective. So let's start then with Dr. Schmitt.

STATEMENTS OF DR. ROLAND W. SCHMITT, SENIOR VICE PRESIDENT, CORPORATE RESEARCH AND DEVELOPMENT, GENERAL ELECTRIC CO.; AND DR. J. LESLIE GLICK, CHAIRMAN AND CHIEF EXECUTIVE OFFICER, GENEX CORP.

Dr. SCHMITT. Thank you, Mr. Chairman.

My name is Roland W. Schmitt. I am senior vice president of corporate research and development of the General Electric Co. I have submitted my testimony to you, and my presentation now will be an abbreviated version of that testimony in order to try to hold within the time limits.

I am pleased to be able to address the committee today on controls on the export of technology and their effect on the health of the technological base of our Nation. These controls also have a major effect on international trade and economic policy, but those obviously are not areas of my expertise. Therefore, I wish to stick to technology.

The United States is in a race with the Soviet Union in defense technology. They, quite frankly, are good at extracting technology from us. Existing laws and regulations have not been enforced strongly enough to prevent technical espionage and the loss of militarily critical equipment. There is a need for tougher enforcement, a step that is being taken, for more thorough screening of applicants and licensees, and for more extensive compliance audits.

But, in taking those steps, we also must ensure that we do not impair the health of U.S. technology to a greater degree than we succeed in blocking that technology leakage. In my view, some of the changes now being proposed for technology export control would halt the flow of technology to the Soviets by strongly impeding our own technical efforts and ultimately crippling our own defense.

I am referring specifically to the broad interpretation of the Export Administration Act of 1979 that has been proposed in informal draft regulations of the Departments of Defense and Commerce. This interpretation would greatly restrict the amount of

technical data that could be given to nationals of friendly countries. I remind you that it is release of technical data to citizens of friendly nations that is the key issue. Release of any unpublished data to nationals of the Eastern bloc already requires Government approval under existing regulations.

I am also referring to attempts by the Department of Defense to exert new controls over access to unclassified research. For example—and Dr. Corson has already remarked on this, but I will repeat it—as a condition of supporting some unclassified research on millimeter wave transistors at Cornell University—research with, it is true, defense implications, but that is a long way from practical application—the DOD specified that no foreign nationals work on the project; that nothing be published without DOD approval; and that no information be transferred to any foreign national. Although compromises were reached on the first two of these points, inability to agree on the third caused the procurement to be canceled.

Now, this new approach, namely, restricting the release of technical data to all foreign nationals, threatens to cause severe disruptions in our R&D capabilities. It would deny to our universities and our industries the capabilities of highly skilled, foreign-born scientists and engineers. It would isolate the United States from world science and alienate the science and engineering communities of our allies. And it would enmesh our technological community in so much restriction and regulation that the productivity of defense research and development would be sharply reduced.

We need a balanced approach that tightens controls without choking creativity. Such an approach must deal with four core issues in the relationship between national security and technology and how they would impact our technological leadership.

The first of these issues is dual use—determining the extent and implications of the use of the same technology in both military and civilian applications. Second, military criticality—determining just how critical a technology is to improving the military capability of potential adversaries. Third, foreign availability—determining whether a technology is freely available to a Soviet bloc country from a foreign source. And, fourth, effective transfer—determining which technology transfer mechanisms must, in fact, be controlled.

Let me start with the dual-use issue. That phrase, dual use, is sometimes used to refer only to applications. But it actually can pertain to fundamental science as well. Generally speaking, the breadth of dual use tends to diminish as you go from fundamental science toward the final application.

Consider microelectronics, for example. At the fundamental science end, the things one has to learn, the scientific facts, are clearly generic to all possible applications. Dual use is complete. The same thing goes for the next stage, namely, the engineering principles. Dual use persists to a large extent in the processes used to make microelectronic chips, for example.

But by the time you reach the application stage, the chips used in military systems are likely to be distinct from the ones used in commercial products. Popular press reports to the contrary, it is unlikely that a chip taken from a video game would really make

possible the development of a technologically superior missile guidance system.

In the final stages of military deployment of technology, the Soviets have in many cases been faster than we have. Recently they sometimes appear to also have been getting better further upstream—further in the direction of engineering principles and fundamental science. This has given rise to the demand for more controls upstream.

Now, I believe that these demands are misguided. Restrictions on those fundamental areas would cost us more in leadership than it would gain us in protection. If you encumber the process of scientific investigation with intricate regulation, you reduce its effectiveness. That work at the fundamental end of the process provides leadership research, educational experience for students, an invaluable forum for access to world science and technology, and the stimulus for important new inventions.

It is not in the fundamental science area but in the areas from engineering prototypes downstream to specific applications that the controls on transfer of technology should be applied.

But the next issue is military criticality. It should clearly be distinguished, in my view, from military utility. A militarily critical technology gives a nation's armed forces a new capability that it did not possess before. A militarily useful technology makes an incremental improvement.

Now, the Department of Defense has compiled a 700-page militarily critical technologies list. The list in its present form is a combination of militarily critical and militarily useful technologies.

The 1979 Export Administration Act required that militarily critical technologies be incorporated into the Commerce Department's commodity control list. Goods and technologies covered by the control list require advance approval when they are released to any foreign national—allies and adversaries alike. So incorporating the technical data covered by the current MCTL into the control list would lead to controls over a vast amount of technical information that is militarily useful but not at all militarily critical. Attempts to enforce such controls would smother our research and innovative capacities and, ultimately, they would collapse of their own bureaucratic weight.

So the MCTL should provide guidance that would allow the control system to differentiate technologies that are truly critical from those that are simply useful. Useful military technologies should be controlled in transactions with Soviet bloc countries, but not in transactions with our allies and friends.

Expanding controls would cause another problem. Release of technical data to a foreign national, even within the United States, is defined by regulation as an export. So restrictions on this information transfer would severely hamper the employment of foreign nationals in U.S. research and development. A very high percentage of the doctoral degrees that are granted in U.S. schools today are going to foreign nationals. The most recent study done by the National Research Council last year found that half of the U.S. engineering doctorates awarded in 1982 were received by foreign nationals, and that 39 percent of all those doctorates, or 78 percent of the foreign nationals, went to foreign nationals on temporary visas.

I can think of nothing that might do more damage to U.S. leadership in science and technology in the next few years than to cut ourselves off from this source. Foreign nationals should be encouraged to participate in fundamental science and engineering in the United States. Even in some of the more applied areas, the need for people is so severe that I believe the State Department, the Department of Defense, and the Commerce Department should find some way to open the doors of applied research and engineering laboratories to foreign nationals who can be adequately screened.

Also, the system of laws and regulations should permit United States research universities and industries to employ and use foreign nationals who have been educated in the United States and who wish to remain here. This is especially urgent in such areas as microelectronics and computer science, which are especially important both to our industry and to our defense.

The next issue is foreign availability. Can a technology be obtained outside the United States?

Now, it is possible to define foreign availability so narrowly that you find that nothing is available in foreign countries. But you have to go beyond carbon-copy availability and consider functional equivalence as well—can the technology available overseas do the same job as the domestically available one?

This concept of functional equivalence has been written into the House bill to update the Export Administration Act. I believe that it belongs in the act.

The other part of this issue is controllability. If a friendly nation already has a technology capability, we can gain more by including them within the control fence than by putting them out. Therefore, I recommend that we permit general licenses for the export to friendly nations of technology that is available to them anyway, and that we seek to strengthen and extend our control agreements to keep that technology from going beyond those countries to the Communist bloc. It is the technology of the West and of Japan, not merely U.S. technology, that is at issue. Our objective must be to create a collaborative multilateral and bilateral system of controls on technology generated by us and by our friends.

Now, there is one more issue to be considered in applying controls, and that is the effectiveness of technology transfer. The transfer of technology out of the laboratory into use is not an easy task—and I can attest to that personally. It is a critical part of the work of an industrial laboratory, and I can assure you that it does not go very well if you rely upon reports and documents alone. Transferring equipment, transferring people, and detailed know-how is much more effective.

In the case of militarily critical microelectronics technology, for example, we should control Soviet acquisition of know-how and of equipment. We should also put strict controls on such things as equipment design drawings. We should not, however, expect to control completely the chips themselves. The chips themselves are so small that we just have to assume that even classified chips will be stolen. So one additional layer of defense is to make the chip immune to reverse engineering—that is, immune to the practice of taking it apart, layer by layer, to find out how it was designed and

made. We must seek a technological solution to this problem, and I believe that one would be possible.

Once we have applied truly workable controls on the effective transfer of technology that is militarily critical, we should not attempt to restrict further the flow of basic scientific and engineering information. Such a restriction would buy us negligible protection in exchange for a considerable sacrifice of our capability for extending our leadership.

Maintaining our scientific and engineering creativity is absolutely vital. Recognition of the value of scientific interchange to this creativity should be at the heart of our policy.

So let me conclude by summing up the recommendations I have made.

First, the areas of fundamental scientific and engineering research should remain unfettered by additional controls, even in dual use areas.

Second, we should distinguish clearly between military criticality and military utility. With technologies that are militarily useful, we should apply less stringent controls on transactions with friendly nations than we apply to the militarily critical technologies.

Third, procedures should be available for screening foreign nationals entering the United States for research training or technical work, so that they can have the same freedom of access to nonclassified technical information as U.S. citizens. Foreign nationals educated in the United States should also be permitted to remain and be employed here if there is a critical need for their skills.

Fourth, foreign availability should be defined in terms of functional equivalence and controllability. We should not require advance approval for exports where the country has functionally equivalent capability and agrees to a system of controls on such exports to the Soviet bloc.

Finally, our export control regulations regarding non-Communist countries should focus on controlling the highly effective technology transfer mechanisms, such as the transfer of equipment and know-how.

Scientific and technological leadership provides a foundation for both our national defense and our economic strength. In preserving and in using that strength, we must seek a balance of leadership and of protection that will enable us to achieve the objective that we all share—that is, assuring that the United States is technologically superior to any adversary in weapons and defense, and that it remains that way.

Thank you.

[The prepared statement of Dr. Schmitt follows:]

STATEMENT OF ROLAND W. SCHMITT, SENIOR VICE PRESIDENT, CORPORATE RESEARCH AND DEVELOPMENT, GENERAL ELECTRIC CO.

My name is Roland W. Schmitt. I am Senior Vice President of Corporate Research and Development of the General Electric Company. Appearing with me is Boyd McKelvain, Manager of National Technology Affairs for General Electric. I am pleased to be able to address the Committee today on controls on the export of technology and their effect upon the health of the technological base of our nation. These controls also have major effects on international trade and economic policy, but those are not my areas of expertise. I will stick to technology.

The United States must remain technologically superior to any adversary in weapons and defense. We are in a race with the Soviet Union in defense technology. Too often, we find that we have superior technology, but they have equal or superior weapons. They are good at extracting technology from us, and good at deploying it rapidly in weapons, while we are good at generating new technology, but are often slow at deploying it in weapons.

Existing laws and regulations have not been enforced strongly enough to prevent technical espionage and the loss of militarily critical equipment information. There is need for tougher enforcement, a step that is being taken, for more thorough screening of applicants and licensees, and for more extensive compliance audits.

But in taking those steps, we also must ensure that we do not impair the health of U.S. technology to a greater degree than

we succeed in blocking technology leakage. In my view, some of the changes now being proposed for technology export control would critically damage the American system that has heretofore led the world in the generation and application of new technology for both defense and civilian uses. Some of these proposals would halt the flow of technology to the Soviets by strongly impeding our own technical efforts, and ultimately crippling our own defense.

I'm referring specifically to the broad interpretation of the Export Administration Act of 1979 that has been proposed in informal draft regulations of the Department of Defense and Commerce. This interpretation would greatly restrict the amount of technical data that could be given to nationals of friendly countries-- to students, employees, consultants, colleagues and customers of Americans. I remind you that it is release of technical data to citizens of friendly nations that is the key issue. Release of any unpublished data to nationals of the Eastern Bloc already requires government approval under existing regulations.

I'm also referring to attempts by the Department of Defense to exert new controls over access to unclassified research. For example, as a condition of supporting some unclassified research on millimeter wave transistors at Cornell University-- research with defense implications, but that is a long way from practical application-- the DoD specified that no foreign nationals work on the project; that nothing be published without DoD approval; and

that no information be transferred to any foreign national. Although compromises were reached on the first two of these points, inability to agree on the third caused the procurement to be cancelled.

This new approach threatens to cause severe disruptions in our R and D capabilities. It would deny to our universities and our industries the capabilities of highly skilled foreign born scientists and engineers. It would isolate the U.S. from world science, alienate the science and engineering communities of our allies, and so provide the Soviets with both psychological and technological advantages. And it would enmesh our technological community in so much restriction and regulation that the productivity of defense research and development is sharply reduced.

We need a balanced approach that tightens control without choking creativity. Such an approach must deal with four core issues in the relationship between national security and technology and how they would impact our technological leadership. The first issue is dual use-- determining the extent and implications of the use of the same technology in both military and civilian applications. Second, military criticality--determining just how critical a technology is to improving the military capability of potential adversaries. Third, foreign availability-- determining whether a technology is freely available to a Soviet bloc country from a foreign source. And, fourth, effective transfer-- determining which technology transfer mechanisms must be controlled.

As I consider these issues, I'll often draw examples from the electronics technologies of very large scale and very high speed integrated circuits--- VLSI and VHSIC-- because they present these issues in their most dramatic form.

Let's start with the dual use issue. The phrase dual use is sometimes used to refer only to applications. But it actually can pertain to fundamental science as well. Generally speaking, the breadth of dual use tends to diminish as you go from fundamental science toward final application.

Consider VLSI for example. At the fundamental science end, the things one has to learn-- diffusion constants, carrier mobilities and lifetimes, and hot electron effects, for example-- are clearly generic to all possible applications. Dual use is complete. The same goes for the next stage, engineering principles. The principles behind ion implantation or a new photolithography step are clearly commmon to military and civilian technologies. Dual use persists to a large extent in the fabrication processes for VLSI.

But by the time you reach the application stage the chips used in military systems are likely to be distinct from the ones used in commercial products. Popular press reports to the contrary, it's unlikely that a chip taken from a video game would really make possible the development of a technologically superior missile guidance system. And it's unlikely that access to such a generally available product could be effectively res-

tricted.

In the final stages of military deployment of technology, the Soviets have in many cases been faster than us. Recently they sometimes appear to have also been getting better further upstream-- further in the direction of engineering principles and fundamental science. This has given rise to the demand for more controls upstream.

I believe that these demands are misguided. Restrictions on those fundamental areas would cost us more in leadership than it would gain us in protection. If you encumber the process of scientific investigation with intricate regulation, you will reduce its effectiveness. That work at the fundamental end of the process provides leadership research, educational experience for students, an invaluable forum for access to world science and technology, and the stimulus for important new inventions.

It is not in the fundamental science area, but in the areas from engineering prototypes downstream to specific applications that the controls on transfer of technology should be applied.

After deciding whether a technology is dual use, we next have to ask about its military criticality. The issue here centers on exactly what we mean by that term. We should clearly distinguish it from military utility. A militarily critical technology gives a nation's armed forces a new capability that it did not possess before--one that is capable of changing the military balance in some area of national defense. A militarily useful

technology makes an incremental improvement, either by providing incrementally better performance, or by enabling a nation to make more of the weapons it already possesses for less money or in less time.

The Department of Defense has compiled a 700-page "Militarily Critical Technologies List". The list in its present form is a combination of militarily critical and militarily useful technologies. And the fact that the list is secret, so that each research worker must guess whether his project is covered, only confuses the situation further.

The 1979 Export Administration Act required that militarily critical technologies be incorporated into the Commerce Department's Commmodity Control List. Goods and technologies covered by the Control List require advance approval when they are released to any foreign national-- allies and adversaries alike. Incorporating the technical data covered by the current MCTL into the Control List would lead to controls over a vast amount of technical information that is militarily useful but not critical. If we attempt to control the millions of such technical interactions with all Free World nations, the system will smother our research and innovative capacities and, ultimately, collapse of its own bureaucratic weight.

So the MCTL should provide guidance that would allow the control system to differentiate technologies that are truly critical from those which are simply useful. Useful military techno-

logies should be controlled in transactions with Soviet Bloc countries, but not in transactions with our allies and friends.

Another concern of expanding controls to such a broad scope of technical data in interactions with all foreign nationals is the impact on our research and development capability. Release of technical data to a foreign national, even within the U.S., is defined as an export. So restrictions on this information transfer would severely hamper the employment of foreign nationals in U.S. research and development. A very high percentage of the doctoral degrees that are granted in U.S. schoools are going to foreign nationals. The most recent study done by the National Research Council last year found that half of the U.S. engineering doctorates awarded in 1982 were received by foreign nationals, and that 39% of all those doctorates went to foreign nationals on temporary visas.

In my view, restricting America's ability to use these people is one of the most threatening factors of all in winning the technology race, whether in military or commercial systems. Doctoral students are the seed corn of technological supremacy, and today a large fraction of that seed corn is foreign born.

I can think of nothing that might do more damage to U.S. leadership in science and technology in the next few years than to cut ourselves off from this source. Foreign nationals should be encouraged to participate in fundamental science and engineering in the U.S. Even in some of the more applied fields, the need

for people is so severe that I believe the State Department, the Department of Defense, and the Commerce Department should find some way to open the doors of applied research and engineering laboratories to foreign nationals who can be adequately screened.

Also, why should we restrict research employment of foreign nationals to whom we have given research training in our own universities? The system of laws and regulations should permit U.S. research universities and industries to employ and use foreign nationals who have been educated in the U.S. and who wish to remain here. This is especially urgent in certain high-technology areas, where there is a shortage of research level people-- such areas as microelectronics and computer science, which are especially important both to our industry and our defense. With the substantial growth in the R&D manpower needs of our high-technology industries and of the Department of Defense, we will need a significant influx of research-trained foreign nationals.

Suppose now that we have found a technology that is dual use, has reached the engineering prototype stage, and has been determined to be militarily critical--all indicating that we should impose strong controls. The next issue is foreign availability-- can it be obtained outside the United States?

There are really two questions here-- what does foreign availability mean, and what impact does it have on controllability? It is possible to define foreign availability so narrowly

that you find that nothing is available in foreign countries. But you have to go beyond carbon-copy availability, and consider functional equivalence as well-- can the technology available overseas do the same job as the domestically available one? To again use an example from VLSI, two computer memory chips might be deemed functionally equivalent if they both pack the same number of bits onto the same area of silicon, with the same access time, even though they achieve this by totally different processes and design rules. The real question is whether the military function can be accomplished in an essentially equivalent way by a technology available to the Soviets from a non-U.S. source.

This concept of functional equivalence has been written into the House bill to update the Export Administration Act. I believe it belongs in the Act.

The other part of this issue is controllability. If a friendly nation already has a technology capability, we can gain more by including them within the control fence than by shutting them out. Therefore, I recommend that we permit general licenses for the export to friendly nations of technology that is available to them anyway, and that we seek to strengthen and extend our control agreements to keep that technology from going beyond those countries to the Communist Bloc.

The essence of our strategy should continue to be what it has been-- to put a fence of export restrictions around the

Soviet Union and its allies to keep technology out. We cannot afford to put the fence around the United States and try to keep our technology in. It is the technology of the West and Japan, not merely U.S. technology, that is at issue. Our objective must be to create a collaborative multilateral and bilateral system of controls on technology generated by us and our friends.

Suppose a technology meets all three criteria discussed so far--it is dual use, it is militarily critical, and it is not available overseas. Then there is one more issue to be considered in applying controls--effectiveness of technology transfer.

The transfer of technology out of the laboratory into use is not an easy task. It is a critical part of the work of an industrial laboratory and I can assure you that it does not go very well if you rely on reports and documents alone. Transferring equipment, people, and detailed know-how is much more effective.

In the case of militarily critical VLSI technology, for example, we should control Soviet acquisition of know-how and equipment--for example, photolithography systems, steppers, ion implanters, and computer-aided design software. We should also put strict controls on such things as equipment design drawings. Once again, the fence protecting these controls must surround other friendly nations, not the U.S. alone, because many of those nations are producing equipment as sophisticated as our own.

In considering the effectiveness of transfer methods, VLSI presents a special problem. Chips are so small that we must

assume that even classified chips will be stolen. One additional layer of defense is to make the chip immune to reverse engineering-- that is, immune to the practice of taking it apart layer-by-layer to find out how it was designed and made. We must seek a technological solution to this problem.

Once we have applied truly workable controls on the effective transfer of technology that is militarily critical, we should not attempt to restrict further the flow of basic scientific and engineering information. Such a restriction would buy us negligible protection, in exchange for a considerable sacrifice of our capability for extending leadership.

Maintaining our scientific and engineering creativity is absolutely vital. It helps us much more than it helps our adversaries. Recognition of the value of scientific interchange to this creativity should be at the heart of our policy.

Let me conclude by summing up the recommendations I have made.

First, the areas of fundamental scientific and engineering research should remain unfettered by additional controls, even in dual use areas. The harm we would do to our leadership by such controls would outweigh any additional protective benefits the controls would provide. U.S. workers in these fields should continue to be able to publish and present their work freely, both at home and abroad.

Second, we should distinguish clearly between military criticality and military utility. With technologies that are militarily useful, we should apply less stringent controls on transactions with friendly nations than we apply to the militarily critical technologies. The Department of Defense and experts in the defense industries must differentiate militarily useful from militarily critical technologies.

Third, procedures should be available for screening foreign nationals entering the U.S. for research training or technical work, so that they can have the same freedom of access to non-classified technical information as U.S. citizens. Foreign nationals educated in the U.S. should also be permitted to remain and be employed here if there is a critical need for their skills.

Fourth, foreign availability should be defined in terms of functional equivalence and controllability. We should not require advance approval for exports where the country has functionally equivalent capability and agrees to a system of controls on such exports to the Soviet Bloc.

And, finally, our export control regulations regarding non-Communist countries should focus on controlling the highly effective technology transfer mechanisms-- such as the transfer of turnkey factories, process equipment, extensive transfer of manufacturing techniques or teaching of those techniques, and co-ventures.

Scientific and technological leadership provides a foundation for both our national defense and our economic strength. In preserving and using that strength, we must seek a balance that avoids both extremes-- regulatory overkill, and no regulation at all. I have tried to outline elements of such a balance. With it, we can achieve the combination of leadership and protection that will enable us to achieve the objective we all share-- assuring that the United States is technologically superior to any adversary in weapons and defense, and remains that way.

Mr. WALGREN. Thank you very much, Dr. Schmitt.
We will go directly to Dr. Glick.

Dr. GLICK. Thank you, Mr. Chairman. I am J. Leslie Glick, chairman of the board and chief executive officer of Genex Corp. I would like to summarize the written testimony that I have submitted to the committee.

Those of us who work in high technology industry—and in my case, it's biotechnology—depend upon the international scientific community. Although many advances in biotechnology are credited to U.S. scientists, those discoveries did not happen in isolation. The worldwide scientific community shares basic knowledge through the established means of technology transfer. You have heard them before today. They are refereed scientific journals, international meetings, and graduate and postdoctoral fellows from many nations studying in leading international laboratories.

I would like to give you some statistics. A couple of these you have already heard. In 1983, one-third of all postdoctoral fellows in U.S. science and engineering laboratories were from foreign countries. Rather than siphoning off technology, these visiting scientists have made numerous contributions to the advancement of science and its applications in the United States. Indeed, for biotechnology alone, there are approximately 9,500 journals currently active in 113 countries in the Western World.

In fact, the better-known discoveries are known for their international interdependence, and I would like to give you some examples. We all know of Watson's and Crick's discovery of the structure of DNA in 1953. Watson was an American postdoctoral fellow and Crick a British graduate student working in a British laboratory when that Nobel prize winning discovery occurred. Previous to their discovery, Erwin Chargaff, an Austrian immigrant to America in the 1930's, had conducted work on the biochemistry of nucleic acids fundamental to Watson's and Crick's progress.

Salvador Edward Luria and Max Delbruk immigrated to the United States from Italy and Germany, respectively, to do leading work in microbial genetics. They subsequently were awarded the Nobel Prize, along with Alfred Hershey, an American, for their pio-

neering role in developing a field that grew into genetic engineering. Three Frenchmen—Jacob, Monod, and Lwoff—won a Nobel Prize for providing the first evidence of regulator genes, but their prize came only after the confirming work was done in U.S. laboratories. Many of the most important results in this work, however, were obtained with the assistance of American postdoctoral fellows working in the laboratories of Jacob, Monod & Lwoff at the Pasteur Institute in Paris. In fact, there is a whole generation of American molecular biologists who have been profoundly influenced by the training they received in the 1950's and the 1960's at the Pasteur Institute. Moreover, many of the leaders in the field of enzyme structure determination, another area crucial to biotechnology, received their training at the Medical Research Council Laboratories in Cambridge, England.

Hybridoma technology, which made possible today's monoclonal antibodies, was discovered in 1975 in England by an Argentinian immigrant to Great Britain. Monoclonal antibodies are today coming to the fore in diagnostic and therapeutic medicine, and the world's leading monoclonal antibody industry is here in the United States. Two of the leading U.S. scientists developing monoclonal antibody technology are immigrants from Poland and Italy.

The first demonstration in 1979 that human interferon could be synthesized in a bacterium was due substantially to the work of a Japanese scientist working in a Swiss laboratory.

In 1977, two scientists working independently discovered the techniques for sequencing DNA—in other words, reading the genetic code. Both won the Nobel Prize for their work, Walter Gilbert from the United States and Frederick Sanger from England. Likewise, the initial techniques for DNA synthesis—that is, making chemically DNA—were the work of Nobel laureate Khorana, who in the 1950's immigrated to the United States from India and today works at MIT. In fact, the DNA chemistry department at my company, Genex, is headed by a U.S. citizen who worked as a postdoctoral fellow in Khorana's laboratory. Moreover, several of our finest scientists in that laboratory are immigrants from India and Pakistan.

As a final example, I should note that Genex's chief scientific officer, David Jackson, was one of three authors of the first scientific paper describing recombinant DNA or gene-splicing. He was a postdoctoral fellow in Paul Berg's laboratory at Stanford when that work was done. The third author was an Australian researcher on sabbatical leave from Australia. Subsequent to their discovery of recombinant DNA, Paul Berg was awarded a Nobel Prize.

So one must ask at what level can export controls be effective. Are we to embargo products, micro-organisms, the enzymes that are the tools of our science, the movement of people, or the movement of the ideas themselves?

Allow me to provide you with something akin to a case study. A recent Wall Street Journal entitled "The Threat of Soviet Genetic Engineering" suggests that the Soviet Union is using genetic engineering to construct novel biological warfare agents. Several conclusions are based on a survey of the Soviet scientific literature where several dozen articles were identified reporting research

being conducted on the effects of various bacterial, viral and animal neurotoxins.

What the series does not state is that a similar survey of the scientific literature in this country and the Western World would uncover hundreds of papers that mention the use of similar toxins, all published by respected research institutions. This is not to say that we in the Western World are seeking novel biological weapons, but that such toxic compounds are useful to scientists as they have sought to understand basic biological events such as nerve conductance, hormone action, and cell reproduction.

In addition, such toxins have great potential in many aspects of medical therapy. For example, cell-specific toxins may become promising therapeutics in cancer treatment. It would be unfortunate if the current outcry over export controls would curtail such medical research, which is being conducted worldwide and is benefitting from the traditional channels of sharing information through the refereed journals and scientific meetings.

One needs to understand that biotechnology, just as any other form of technology, offers the potential for both advantageous use and abuse. A molecular biologist could conceive of ways to genetically engineer innocuous bacteria to produce deadly toxins. But, assuming that the intent of export controls on biotechnology is to prevent the creation of such weapons, we must ask the question of whether such embargoes would work.

Let's consider what would be required to construct a novel biowarfare agent. One needs a gene or genes that are responsible for a particular toxin; a micro-organism in which those genes could be inserted; and a relatively small number of enzymes to conduct the genetic engineering.

It might be possible to embargo certain poisonous snakes that are indigenous to this country, but many of the most potent toxins are found in organisms outside the United States. There is simply no effective way to control dissemination of these compounds or the organisms from which their genes could be isolated.

Nor could the micro-organisms in which these genes would be cloned be effectively regulated. Such micro-organisms are present everywhere.

Finally, export controls on the enzymes required to conduct genetic engineering would be no more effective. Although a number of U.S. companies manufacture such enzymes for export abroad, ours are by no means the only manufacturers. A number of European and Japanese companies are engaged in such production.

Export controls would thus markedly harm our country's ability to compete in overseas markets. And, should a unilateral Western embargo prohibit the Soviet Union from obtaining the enzymes, this, too, would be ineffective, for the methods for the isolation and purification of such enzymes, as well as the techniques for genetic engineering, are already well-documented in the scientific literature.

It is certain that we in the United States have benefited from such foreign innovation in our own product and process development. But on a more practical scale, technology transfer should be viewed as but one step in the normal course of business with a company's clients, whether they are foreign or domestic. For exam-

ple, when my company agrees to accept a client-sponsored research project, we generally gain the benefit of that client's knowledge and experience in its markets and technology, while applying our technical expertise to the problem at hand. Additionally, it is not at all unusual for us to be able to use the manufacturing processes and applications we gain from our clients in the development of our own proprietary products.

Our success in client-sponsored projects, moreover, offers us long-term economic benefits that are crucial for our company's industrial success. Generally, we retain patent rights and license the technology to our clients for predetermined uses in specific geographic areas. Those clients, all of whom are in the Western World, then pay us royalties on sales resulting from the innovative products or processes. In the long term, such royalty and licensing arrangements will do much to bring stable profits to high technology industry in the United States, and a leadership position in world trade.

Also something that is not too often appreciated is that a largely R&D dependent industry such as biotechnology is in great need of startup and sustaining capital in its early years. For biotechnology, the availability of venture capital in the United States has depended heavily on industrial R&D contractual commitments. American industry was initially not as willing to fund R&D in biotechnology, but contracts did come from foreign companies willing to risk their R&D funds on what was then unproven technology. In turn, American venture capitalists were eager to provide equity financing to those companies capable of securing such research contracts. Those early international contracts resulted both directly and indirectly in the pivotal funds that built our industry.

Export control policies, therefore, that tend to wall off U.S. science offer more potential harm than effective leverage. Secrecy can only jeopardize scientific inquiry and weaken our stance in this interdependent world. The challenge in this country is to foster our system of innovation and keep our technology at the leading edge of worldwide competition. Exports controls on science will, in that regard, hurt more than help.

Thank you.

[The prepared statement of Dr. Glick follows:]

STATEMENT BY J. LESLIE GLICK, CHAIRMAN AND CHIEF EXECUTIVE OFFICER, GENEX CORP.

Mr. Chairman: I appreciate this opportunity to address you and the Committee on some of the issues surrounding the debate on scientific inquiry and national security. It is an important debate with a notable challenge: to find a sensitive balance between protecting our national security interests--both military and economic--without discouraging international commerce or the free flow of scientific inquiry.

Early debate over export control centered on clearly strategic products or the technologies that create the more sophisticated of our military weaponry. But increasingly, the issues for debate include a longer grab-bag list of technologies, and the transfer of such technologies to foreign companies throughout the free world, or even between U.S. companies and their foreign subsidiaries. Now proposals and questions are arising that threaten to embargo the free flow of ideas through the traditional channels of scientific exchange.

Those of us who work in high technology industry, in my case the extension of "genetic engineering" that is more accurately termed biotechnology, are keenly aware of the interdependence of the world's scientific community. Ours is a technology that has developed only a dozen years from one of its most significant events: the invention of recombinant DNA, or "gene splicing," technology. As recently as 1977 most molecular geneticists thought it would be another decade before human interferon were made in a bacterium. That milestone occurred a mere 2 years later.

Although many advances in biotechnology are credited to U.S. scientists and/or their laboratories, those discoveries did not happen in isolation. The worldwide scientific community shares basic knowledge through the established means of technology transfer: refereed scientific journals, international meetings, and graduate and postdoctoral fellows from many nations studying in leading international laboratories.

In 1983, one-third of all postdoctoral fellows in U.S. science and engineering laboratories were from foreign countries.[1] Rather than siphoning off technology, these visiting scientists have in fact made numerous, important contributions to the advancement of science and its applications in the United States. Indeed, serving biotechnology alone, there are approximately 9,500 journals currently active in 113 countries in the Western world.[2] And many international meetings each year draw myriads of scientists to hear papers and explore openly the knowledge basic to the conduct of biotechnology's research.

Nor have the better-known discoveries been without their international interdependence. We all know of James Watson's and Francis Crick's discovery of the double helical structure of DNA in 1953. It is well to remember that Watson was an American postdoctoral fellow and Crick a British graduate student working in a British laboratory when that Nobel-prize winning discovery occurred. Previous to their discovery, Erwin Chargaff, an Austrian immigrant to America in the 1930's, had conducted work on the biochemistry of nucleic acids fundamental to Watson's and Crick's progress.

Other prominent molecular geneticists provide further evidence of the small world nature of the international scientific community. Salvador Edward Luria and Max Delbruk immigrated to the United States from Italy and Germany, respectively, to do leading work in bacterial and phage mutation. They subsequently were awarded the Nobel prize along with Alfred Hershey, an American, for their pioneering role in developing the field of molecular genetics, a field that grew into genetic engineering. Three Frenchmen, Francois Jacob, Jacques Monod, and Andre Lwoff won a Nobel prize for providing the first evidence of "regulator" genes, but their prize came only after the confirming work was done in U.S. laboratories. Moreover, many of the most important results in this work were obtained with the assistance of American postdoctoral fellows working in the laboratories of Jacob, Monod, and Lwoff at the Pasteur Institute in Paris. Indeed, there is a

whole generation of American molecular biologists who have been profoundly influenced by the training they received in the 1950s and 1960s at the Pasteur Institute. Similarly, many of the leaders in the field of enzyme structure determination, another area crucial to biotechnology, received their training at the Medical Research Council Laboratories in Cambridge, England.

Since the 1972 discovery of recombinant DNA technology commercial applications have grown by increasing proportions, but the basic science continues to proceed. Hybridoma technology, which made possible today's monoclonal antibodies, was discovered in England by Cesar Milstein, an Argentinian immigrant to Great Britain in 1975. Monoclonal antibodies are today coming to the fore in diagnostic and therapeutic medicine, as well as holding promise in vaccine development. And, the world's leading monoclonal antibody industry is here in the United States. Two of the leading U.S. scientists working on developing advanced monoclonal antibody technology, including human monoclonals, are Hilary Koprowski and Carlo Croce, immigrants from Poland and Italy, respectively.

Incidentally, the first demonstration that human interferon could be synthesized in a bacterium was due substantially to the work of a Japanese scientist working in a Swiss laboratory.

In 1977, two scientists working independently, oceans apart, discovered the techniques for "sequencing" DNA--in other words, reading the genetic code. Both won the Nobel prize for their work, and this work of Walter Gilbert from the United States and Frederick Sanger from England is today a basic tool in any genetics laboratory. Likewise, the initial techniques for DNA synthesis--making chemically a copy of any given strand of DNA--were the work of Nobel laureate Har Gobind Khorana, who in the 1950s immigrated to the United States from India and today works at MIT. In fact, the DNA chemistry department at Genex is headed by a man who worked

as a postdoctoral fellow in Khorana's laboratory, and several of our finest scientists in that laboratory are immigrants from India and Pakistan. Genex's roster of prominent scientists does, in fact, include many who have come to the United States from several foreign countries.

As a final example, I should note that Genex's Chief Scientific Officer, David Jackson, was one of three authors of the first scientific paper describing the recombinant DNA technique. He was a postdoctoral fellow in Paul Berg's laboratory at Stanford when that work was done. The third author, Robert Symons, was an Australian researcher on sabbatical leave from the University of Adelaide.

So, one must ask at what level can export controls be effective? Are we to embargo products, organisms, the restriction enzymes that are the tools of our science, the movement of people, or the movement of the ideas themselves? To provide some guidance in this debate, I would like to address some of the questions raised in a recent Wall Street Journal series, "The Threat of Soviet Genetic Engineering."

This editorial series suggests, unfortunately through circumstantial evidence and innuendo, that the Soviet Union is engaged in using the techniques of genetic engineering to construct novel biological warfare agents. One segment of the series, and several of its later conclusions, is based on a survey of the Soviet scientific literature, where several dozen articles were identified reporting original research being conducted on the effects of various bacterial, viral, and animal neurotoxins.

What the series does not state is that a similar survey of the scientific literature in this country and the Western world would uncover hundreds of papers that mention the use of such compounds as cholera and diptheria toxins, as well as components from bee and snake venoms, all published by respected academic, private, and governmental research institutions. This

is not to say that we in the Western world are seeking novel biological weapons--as is charged of the Soviet Union--but that such toxic compounds are useful to scientists as they have sought to understand basic biological and physiological events such as nerve conductance, hormone action, and cell reproduction.

In addition, though it may appear surprising, such toxins have great potential in many aspects of medical therapy. Biomedical research is looking into the knowledge gained to create, for example, cell-specific toxins that might become promising therapeutics in cancer treatment. The use of toxins for such applications involves the linkage of the toxin's subunit to a specific immunoglobulin or antibody that would recognize only the cancer cells. Such immunotoxins would then selectively kill cancer cells, leaving normal cells alone. It would be unfortunate if the current outcry over export controls would curtail such medical research--which is being conducted worldwide and is benefiting from the traditional channels of sharing information through the refereed journals and scientific meetings.

One needs to understand that biotechnology, just as any other form of technology, consists of important and basic scientific tools. These tools offer the potential for both advantageous use and abuse. Just as turbines can power commercial aircraft and bombers, chemicals can be used to make consumer products and poison gas, and radioactive materials can be used in medical diagnostics and bombs, so can biotechnology be used to produce products beneficial to mankind as well as military weapons. A molecular biologist could conceive of ways to genetically engineer innocuous bacteria to produce deadly toxins. But, assuming that the intent of export controls on biotechnology is to prevent the creation of such weapons, we must ask the question of whether such embargoes would work.

Let us consider what would be required to construct a novel biowarfare agent. One needs:

1. The gene or genes that code for a particular toxin;

2. a bacterial host; and

3. a relatively small number of enzymes (basic tools) to conduct the genetic engineering.

It might be possible to embargo certain poisonous snakes that are indigenous to this country--water moccasins and certain species of rattlesnakes--but this would accomplish little. Many of the most potent toxins are either available from strains of bacteria or are found in animals from regions outside the United States. Included are batrachotoxin from a Columbian frog, tetrodotoxin from a Japanese fish, ricin from the widely available castor bean, and of course cobra toxin from the Indian snake. There is simply no effective way to control dissemination of these compounds or the organisms from which their genes could be cloned.

Nor could the bacterial host be effectively regulated. Bacterial species are present everywhere, and they multiply rapidly using relatively inexpensive nutrients. A small vial of bacteria can be grown up into gallon quantities in a very short time.

Finally, export controls on the enzymes required to conduct genetic engineering would be no more effective. Although a number of U.S. companies manufacture such enzymes for export abroad, ours are by no means the only manufacturers. A number of European and Japanese companies are engaged in such production.

Export controls would thus markedly harm our country's ability to compete in overseas markets. And, should a unilateral Western embargo prohibit the Soviet Union from obtaining the enzymes, this, too, would be ineffective, for the methods for the isolation and purification of such enzymes--as well as the techniques for genetic engineering--are already well-documented in the scientific literature.

It is certain that we in the United States have benefited from such foreign innovation in our own product and process development. But on a more practical scale, technology transfer should be viewed as but one step in the normal course of business with a company's clients, whether they be foreign or domestic. For example, when my company agrees to accept a client-sponsored research project, we generally gain the benefit of that client's knowledge and experience in its markets and technology, while applying our technical expertise to the problem at hand. Additionally, it is not at all unusual for us to be able to use the manufacturing processes and applications we gain from our clients in the development of our own proprietary products.

Moreover, our success in client-sponsored projects offers us long-term economic benefits that are crucial for our comany's industrial success. Negotiated in advance of each research contract is a system of patent protection for those discoveries that follow, and the means of commercializing those rights that flow from the resulting patents. Generally, our company retains patent rights and licenses the technology to our clients for predetermined uses in specific geographic areas. Those clients, all of whom are in the Western world, then pay us royalties on sales resulting from the innovative products or processes. In the long-term, such royalty and licensing arrangements will do much to bring stable profits to high technology industry in the United States--and a leadership position in world trade.

Also worthy of note here is the fact that a largely R&D dependent industry, such as biotechnology, is in great need of start-up and sustaining capital in its early years. In these pioneering years of the biotechnology industry, the availability of venture capital in the United States has depended heavily on industrial R&D contractual commitments. American industry was initially not as willing to fund R&D in the new biotechnology, but contracts did come from foreign companies willing to risk their R&D funds on what was then unproven technology. In turn, American venture capitalists were eager to provide equity financing to those companies capable of demonstrating both scientific and business acumen. Those early international contracts resulted both directly and indirectly in the pivotal funds that built our industry.

Thus, export trade policies that aim at "protecting" U.S. science--toward whatever application--offer more potential harm than effective leverage. Secrecy can only jeopardize scientific inquiry and weaken our stance in this interdependent world. The challenge in this country is to foster our system of innovation and keep our technology at the leading edge of worldwide competition. Export controls on science will, in that regard, hurt more than help.

References

1. Commercial Biotechnology: An International Analysis, U.S. Congress Office of Technology Assessment, Washington, D.C., 1984.

2. Serial Sources for the Biosis Data Base, Biosciences Information Service, 1983.

Mr. WALGREN. Thank you very much, Dr. Glick. You certainly make the strong point that this is an interdependent world. I guess it's not just in your industry, but if you think back on what we imported after World War II, or in the process of World War II, clearly our level of technological development has been so substantially driven by imported talent that we ought to take full account of that.

Have you had any direct experience with this kind of restraint by the Government? At this point, I guess, biotechnology is a relatively new area. Someone said that they had asked for an explanation about a product or something to that effect. What has been your experience with export limitations?

Dr. GLICK. At present, we have not had any problems in that regard. We have had some concerns expressed. I am aware of perhaps one or two other companies that have been questioned by government officials concerning export of their technology, but to date, there has not been any stifling of the dissemination of this technology to Western countries.

Our concern, of course, is what will happen in the future.

Mr. WALGREN. Do you feel that at least the present state of knowledge is something that could usefully—I know in your testimony you say you can't limit it, at least physically. The resources are over there. The ideas—I guess what you're talking about is limiting an idea at that point from transferring across. Perhaps in other areas it's been emphasized that in order to make effective use of these developments people had to have more—well, it wasn't so much the document or the words or the idea, but experience with the machinery and the physical laboratory equipment that seemed to be beneficial.

Is that less true in biotechnology than in other areas?

Dr. GLICK. I think the point to emphasize here is that, with respect to biotechnology, there are many advanced groups around the world. We here in the United States tend to think of this country by being at the leading edge, having close to a monopoly on certain areas of technology, and that, of course, is not true. We simply have more of it because we are maybe 200 and some odd million people compared to another country that might be only 20 million. But, in fact, the same state of sophistication exists, and in many areas on a per capita basis. We have to keep that into account.

Mr. WALGREN. So in your area it is just something that can't be walled off; it's just not a physical possibility?

Dr. GLICK. I honestly don't know how it could be done.

Mr. WALGREN. Dr. Schmitt, I wanted to ask you if you would comment on the Corson panel's suggestions in recognizing the interests we have in not transferring sensitive technology. You set out pretty specific considerations to be taken into effect. Would your suggestions be compatible with the Corson approach?

Dr. SCHMITT. Well, I think the recommendations of the Corson report and the recommendations that I have made stem from the same interest and objectives. I must say that with respect to the Corson report the gray area, as has already been noted, has been the difficult issue. Because it has been struggled with for well over a year now, without any satisfactory resolution, I think one has to come to the conclusion that that concept may have to be revisited.

The use of the gray area concept may not be as workable as first envisaged.

The second statement I would like to make about the Corson report is that at the beginning of that study I was concerned that the study was not encompassing industrial R&D as well as academic R&D, because I think a lot of the same principles apply to the more basic and fundamental end of industrial R&D as apply to academics. I am pleased to note that the National Research Council has now undertaken what they call—or I guess they're in the process of undertaking—what they call Corson II, which as I understand it will, in fact, look at industrial R&D also.

I would hope that when that study is completed that the Federal Government will proceed to follow its recommendations and suggestions more rapidly and with a greater degree of diligence than has been true of the Corson report.

Mr. WALGREN. Except it appears they didn't really want to pick up the Corson report in its limited spirit, and if they came out with a similar report that they did not want to pick up, we wouldn't particularly want them to proceed with all unconsidered speed, would we not?

Dr. SCHMITT. Well, I agree with that. If the recommendations are poor, one wouldn't want them to proceed with due speed.

Mr. WALGREN. The university people indicated that they felt there really was one set of approaches that should apply to both commercial and university-based basic research—I guess at that point they're talking about.

Could you highlight any distinctions or different approaches that you feel could be or should be taken into account between the universities on the one hand and the industry sector?

Dr. SCHMITT. Yes. One fact of industrial research that is different from university research is that it proceeds obviously much further in the direction of applications and development. It gets into the area of proprietary information. I think industrial laboratories, by and large, are very skilled and knowledgeable about how to deal with proprietary results of R&D in a manner that gives you a competitive advantage, and yet interacts with the rest of the technical community in a way to stimulate it. That is clearly a difference between the academic community and the industrial community.

I think that fundamentally, though, I have to say this; that if you look at the results of R&D, the results of scientific advancement alone, that it is always better to have it open and free. The reason that one doesn't have complete openness and complete freedom in an industrial laboratory is because it is necessary at some stage to try to get a competitive advantage against the Japanese or European or even American competitors you're dealing with.

I know a statement was made here at the table earlier that secrecy did not affect development as much as it affected basic research. I do not believe that to be true. I think that secrecy impedes development also. However, it is a necessary thing to do at times and one has to pay that price.

Mr. WALGREN. The concept of screening foreign nationals in advance, do you think that's workable?

Dr. SCHMITT. It is my understanding that the State Department has said that one criterion for the issuances of visas already is the

potential loss of technical information. So, in principle, as I understand it, they would concur that that's a criterion that could be applied.

Let me say that it is a lot more feasible than the alternatives being proposed; namely, to try to limit the flow of technical information to foreign nationals on campuses or in industrial laboratories for that matter.

Mr. WALGREN. You raised the importance of considering the West as a unit and that the real problems lie in trying to assure that prevention of transfer across the East-West boundary.

On a scale of 1 to 10, comparing the danger of things adversely affecting us if they are found out from universities versus the transfer from other countries, which do you weight as a greater danger or should be given greater attention by our political process?

Dr. SCHMITT. Well, I think the statement made earlier, about there being no evidence for any adverse loss of information from publications of basic research, is something that crosses boundaries. I mean, that's true, no matter whether you speak of the United States, you speak of Japan, or you speak of Europe. So I wouldn't cast the issue so much in terms of whether it is in the United States or in Europe as I would the type of information it is and whether, in fact, we can control it unilaterally. I think that the mistake we make is to believe that a lot of this technology is possessed by us and by us alone. That simply is becoming less and less true today.

As a matter of fact, in the past 10 years the R&D expenditures of our four major allies—Japan, England, France, and Germany—now exceeds the expenditures of the United States. That was not true 10 years ago. So the trends are in a direction to—I was talking in absolute dollars there, too. So it's just an issue that is not a unilaterial U.S. issue.

Mr. WALGREN. Well, on behalf of the committee, let me express my appreciation to both of you.

Is there anything, Dr. Glick, you would like to add? I want to give you certainly that opportunity if there is any comment you would like to make on any of the testimony previously heard this morning.

Dr. GLICK. No, Mr. Chairman.

Mr. WALGREN. All right. Well, thank you very much. We appreciate both your coming and we like to consider you a resource for the committee. Thank you.

Our third panel is Dr. Edith Martin, Deputy Under Secretary for Research and Advanced Technology from the Department of Defense; Mr. William Archey, Acting Assistant Secretary for Trade Administration of the Department of Commerce; and Dr. James Kane, the Deputy Director of the Office of Energy Research in the Department of Energy.

We would be pleased if you would come forward. I certainly want to welcome you to the committee.

Also, at this point I want to recognize our colleague from Kansas, Mr. Glickman, who has joined us. I will give Mr. Glickman an opportunity to make any comments and observations that he would want.

Mr. GLICKMAN. Thank you, Mr. Chairman.

I have an opening statement that I would like included in the record at this point.

I would only like to make the comment that our subcommittee held some hearings over our general period of oversight and authorization of the Department of Energy's budget on the issue of ceramics materials, gas turbine engines, and related activities. We saw the example and heard testimony from people who fear that the Department of Defense's proposed guidelines, as well as other agencies of the Government, to restrain exports of certain advanced materials, nonclassified materials as opposed to classified issues, may have an extraordinarily harmful effect on basic research in this country.

There seems to be an attitude, as far as I can perceive, where the Pentagon is making the judgment that almost everything that is exportable from America ought to be run through their shop before the fruits of the labor of American manufacturers and workers can benefit from selling items overseas. Nobody disputes that classified material ought to be subject to proper restrictions. I guess what we do object to is going beyond the bounds of reasonableness. So I hope that the witnesses can address that today.

I am most appreciative of you letting me set in.

Mr. WALGREN. Thank you very much. That statement will be entered in at this point in the record.

[The prepared statement Mr. Glickman follows:]

STATEMENT OF HON. DAN GLICKMAN, CHAIRMAN, SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS, COMMITTEE ON SCIENCE AND TECHNOLOGY

Mr. Chairman, I would like to take this opportunity at the outset to thank you for allowing me to participate in this hearing on scientific communications and national security. The Subcommittees on Science, Research and Technology, and Investigations and Oversight are to be congratulated for continuing to focus on this extremely important issue. The Subcommittee on Transportation, Aviation and Materials certainly shares your concern for this matter.

At first glance, the question of scientific communications and security seems rather esoteric and theoretical. Unfortunately, when examined carefully, the consequences of policies and regulations now evolving in this area have very real and potentially very negative effects in specific federal programs and scientific and technological areas. During this year's authorization of DOE's and NASA's research programs, our attention was brought to bear on certain guidelines pertaining to export control of advanced materials. Witnesses stated that such controls could have long-term and long-lasting effects on advanced materials programs now underway in DOE, NASA, NSF and elsewhere. Both industry and academic experts fear that advanced materials research and information exchanges will be severely hampered as a result of these guidelines. From the perspective of industry, such curtailment will prevent or severely encumber their ability to compete in the international marketplace where these materials have broad commercial applications. From the academic perspective, although assurances are given that "basic scientific data . . . is considered appropriate for open exchange", it will prove extremely difficult to make the necessary distinction between "basic" vs "applied" information or research.

More recently, the Department of Commerce has published certain proposed regulation under the Export Administration Act due for final comment and implementation on May 29. The proposed regulations impose controls not only on specific commodities but on the "know-how" and technical data related to processes. Since processing is at the heart of all advanced materials research, there is literally no program, grant or materials research activity that would not be potentially covered by these restrictive regulations. This includes research supported by the private sector as well as all Federal research funding, sponsored by DOD or not. Such regulations would apply, for instance, to advanced materials technologies for semiconductor devices; in other words, computer "chips" for state-of-the-art super computers and re-

lated devices; they would apply to advanced ceramic materials for new energy efficient heat engines; and they would apply to new polymer-based composite materials important to advanced civilian aircraft.

I believe we must be very careful in evaluating the effects of these and related regulations before we allow them to be implemented. As such, I am looking forward today to questioning a number of the government representatives here today. In particular, I am interested in hearing their responses to the long-term effects on our research enterprise in lieu of these broadly sweeping regulations and guidelines.

Mr. WALGREN. Let me ask Dr. Martin to go first. We will go through the witnesses in the order in which we called you. Again, written statements will be made a part of the record, and please summarize and outline the important points that you feel should be made in whatever way you feel most comfortable.

Dr. Martin.

STATEMENTS OF DR. EDITH W. MARTIN, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING (RESEARCH AND ADVANCED TECHNOLOGY); WILLIAM T. ARCHEY, ACTING ASSISTANT SECRETARY FOR TRADE ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE; AND DR. JAMES S. KANE, DEPUTY DIRECTOR OF ENERGY RESEARCH, DEPARTMENT OF ENERGY

Dr. MARTIN. Thank you, Mr. Chairman. It is my privilege to be here today to present the Department's views on scientific communication and national security. I do regret that the university representatives are unable to be with us.

The chart that we have here should help you visualize several points I want to make. Over the past few years the U.S. lead in technological capabilities in military systems over that of the Warsaw Pact has decreased substantially. This is a result of several factors, including increasing Soviet investments in R&D, Soviet ability to incorporate new technology into military systems more rapidly than we do, and systematic Soviet acquisition of Western technology both through legal and illegal means.

In 1982, the U.S.S.R. spent between 14 and 16 percent of gross domestic product on the military, compared to around 3.8 percent for the European NATO countries, and 6.5 percent for the United States. Soviet defense outlays continue to grow from this very high base. This investment profile has provided the Warsaw Pact with significant quantitative advantages in many key military systems, such as intercontinental-range missiles, tanks, and attack submarines.

The United States, for social, economic, and political reasons, has chosen not to compete with the Soviet Union in quantity of military weapons and forces. Instead, the United States and its allies have sought to offset the Soviet quantitative advantage through the exploitation of superior technology in their weaponry. As the Deputy Under Secretary of Defense for Research and Advanced Technology, my responsibility is to oversee the investment of nearly $5 billion annually to assure that we are not caught by technological surprise and that we, indeed, have that superior technology. Recognizing that it is not possible to protect any given technology forever, U.S. policymakers have concluded that it is essential to protect our technological lead times. I think everyone here would agree to do otherwise would be irresponsible. Now, if the United

States is to have a margin of safety, it is surely embodied in these lead times.

Now, from the chart you can see that the lead time has been decreasing. Our requirement is once again to widen the gap. To maintain our technological lead, we can increase our efforts to advance technology, we can attempt to slow down the flow of militarily useful technologies to our potential adversaries, or we can do both. It seems to me that doing both is necessary.

Our goal has been to seek a balance which limits adversary access to our military technologies as much as possible, while maintaining the ability of our Nation to perform the research that gave us the technological lead in the first place.

Most of the basic research in science and engineering supported by the Department of Defense is performed in university centers, with research workers competing with one another to be the first to discover and the fastest to apply their findings.

The world of science is international in character. American researchers meet and interact with the best researchers from other nations, exchanging ideas and information so that everyone benefits. Our university system, made much stronger by such interactions, is today the envy of the world.

Until recently, research in universities has not caused significant concern with respect to handling defense information. This situation, however, has been complicated by other trends and changes.

First, the 1976 Bucy report moved the focus of export controls from goods to the technology used to produce goods. Second, some American universities are becoming more and more involved in applied and manufacturing technologies. And third, it is becoming more and more difficult to distinguish between military and commercial technologies.

Now, there is no doubt that universities have contributed greatly to national security. The classified work on radar at the Radio Research Laboratory at Harvard and the Radiation Laboratory at MIT saved the lives of thousands and was of great assistance in winning World War II. Doppler sound techniques developed at the Georgia Institute of Technology are being used to detect submarines and to make our seas safer.

The importance of universities as major performers in defense research and development is growing. About half of all defense basic research—that's all of budget category 6.1—is spent in universities. That was over $400 million in 1984.

DOD relies upon and fosters university basic research and encourages dissemination of research results throughout the world's scientific community in order to maximize the benefits of our investment. In addition, about $500 million will be spent in universities on applied research and development, with about $400 million of that $500 million going to two large research centers—Lincoln Laboratories at MIT, and the Applied Physics Laboratory at Johns-Hopkins University. These facilities are located off-campus and perform both classified and unclassified research for DOD.

In the case of classified research, great caution is obviously exercised in the dissemination of the information that is generated.

It is our sincere belief that technology cannot be protected without the cooperation of the technologists. Open, frank and continu-

ing dialog on that topic is absolutely necessary for mutual understanding. We have attempted to provide the opportunity for continued discourse by making the DOD-university forum, along with its working groups, an official advisory body to the Department of Defense.

Now let me say a few words about the DOD-university forum. It is a group of 21 individuals drawn almost equally from DOD and the university research community, who meet twice yearly to discuss matters of mutual interest to DOD and academia. The forum is cochaired by the Under Secretary of Defense for Research and Engineering, Dr. Richard D. DeLauer, and Dr. Donald Kennedy, president of Stanford University. It is cosponsored by DOD and three major higher education associations: The Association of American Universities, the American Council on Education, and the National Association of Universities and Land-Grant Colleges.

Supporting the forum currently are three primary working groups, one on technology export control, one on foreign languages and area studies, and one on engineering and science education. The DOD-university forum, through its working group on export control, has participated in reviewing technology transfer policies being considered by the Department as they evolved. That interaction was invaluable. It ensured that DOD proposals were understood and that the policies took account of all positions. As a result of the genuine will to cooperate, and of openness and candor, a significant level of agreement was reached between academic and Government communities during the past year. Those who participated in that process can truly testify to the effectiveness of the exchanges.

Within DOD a major accomplishment for the university and research community resulted from the work of the DOD Ad Hoc Steering Committee on National Security and Technology Transfer. Thanks to the cooperation of many within DOD, research and development is now given separate consideration in the context of export control policy. It led to a major revision of a DOD directive and the establishment of a new panel on R&D.

We are encouraged by the recognition of the importance of science and technology and its distinct character as compared to acquisition. This recognition represents, I believe, a commitment on the part of all components of the Department of Defense.

I would like to add a few other comments. I think there are some points that should be made very clear. One is, DOD has never proposed and does not currently propose control of basic, fundamental research.

Second, the Corson panel, which was comprised of esteemed, objective and very patriotic people, gave us their best assessment of the technology transfer situation. These individuals stated their belief that a problem, or potential problem, did exist. Had their conclusions been otherwise, we would not be sitting here today.

Now, having cochaired the DOD-university forum panel on export control, and chaired the DOD Ad Hoc Steering Committee on National Security and Technology Transfer, I can attest to the level and sincerity of our efforts to implement the spirit of the Corson report recommendations.

It has now been 20 months since the Corson report was completed and accepted by the Secretary of Defense. I have chaired within DOD, and cochaired with the universities, endeavors to implement the gray areas for 17 months. We, within DOD and OSTP, have determined that the gray area concept is good in theory but not workable in practice. For this reason, we have in circulation within the Government for concurrence a draft administration policy which reads as follows:

> It is the policy of this administration that the mechanism for control of fundamental research in science and engineering at universities and Federal laboratories is classification. Each Federal Government agency is responsible for (a) determining whether classification is appropriate prior to award of a research grant or contract, and, if so, controlling the research results through standard classification procedures; (b) periodically reviewing all research grants or contracts for potential classification. No restrictions may be placed upon the conduct or reporting of research that has not received national security classification.

Mr. Chairman, we appreciate the opportunity to share our concerns with your committee and welcome your cooperation as we strive to increase our knowledge base, strengthen and assist our universities, and accelerate our technological progress. At the same time, we must fulfill DOD's mission by keeping our technological capability well above that of our adversaries. We cannot afford to gratuitously build up an enemy's military or manufacturing technology base which might one day be used to damage or destroy this Nation. I believe we have made much headway in the past 12 months, thanks to the assistance so generously provided by many public spirited individuals. I am confident that we shall continue to make excellent progress in the future.

I certainly thank you for this opportunity to speak and at the appropriate time will be glad to accept any questions you may have. Thank you.

[The prepared statement of Dr. Martin follows:]

HOLD UNTIL RELEASED BY
THE SUBCOMMITTEES

STATEMENT

OF

DR. EDITH W. MARTIN

DEPUTY UNDER SECRETARY OF DEFENSE

FOR RESEARCH AND ENGINEERING

(RESEARCH AND ADVANCED TECHNOLOGY)

ON

SCIENTIFIC COMMUNICATIONS AND NATIONAL SECURITY

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

AND THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

OF THE

U.S. HOUSE OF REPRESENTATIVES

MAY 24, 1984

GOOD MORNING. MY NAME IS EDITH MARTIN AND I AM DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ADVANCED TECHNOLOGY. I AM PLEASED TO BE HERE TODAY TO PRESENT THE DEPARTMENT'S VIEWS ON "SCIENTIFIC COMMUNICATIONS AND NATIONAL SECURITY."

THE CHART SHOULD HELP YOU VISUALIZE SEVERAL POINTS I WANT TO MAKE. OVER THE PAST FEW YEARS THE U.S. LEAD IN TECHNOLOGICAL CAPABILITIES IN MILITARY SYSTEMS OVER THAT OF THE WARSAW PACT HAS DECREASED SUBSTANTIALLY. THIS IS A RESULT OF SEVERAL FACTORS INCLUDING: INCREASING SOVIET INVESTMENTS IN R&D, SOVIET ABILITY TO INCORPORATE NEW TECHNOLOGY INTO MILITARY SYSTEMS MORE RAPIDLY THAN WE DO, AND SYSTEMATIC SOVIET ACQUISITION OF WESTERN TECHNOLOGY THROUGH BOTH LEGAL AND ILLEGAL MEANS.

NATO ESTIMATES INDICATE THAT THE USSR HAS CONTINUED TO SPEND BETWEEN 14 AND 16 PERCENT OF GROSS DOMESTIC PRODUCT ON THE MILITARY COMPARED TO AROUND 3.8 PERCENT FOR EUROPEAN NATO COUNTRIES AND 6.5 PERCENT IN THE UNITED STATES IN 1982. SOVIET DEFENSE OUTLAYS CONTINUE TO GROW FROM THIS HIGH BASE AT A RATE OF ABOUT 2.5 PERCENT A YEAR. THIS INVESTMENT PROFILE HAS PROVIDED THE WARSAW PACT WITH SIGNIFICANT QUANTITATIVE ADVANTAGES IN MANY KEY MILITARY SYSTEMS (E.G., INTERCONTINENTAL-RANGE MISSILES, TANKS, ATTACK SUBMARINES).

WHILE THE WEST, DRIVEN BY COMMERCIAL MARKET FORCES, HAS APPLIED ITS MANUFACTURING KNOWHOW AND INNOVATIVE CAPABILITIES PRIMARILY TO PEACEFUL USES, THE SOVIET UNION APPEARS TO CONCENTRATE ON THE DEVELOPMENT OF WAR MACHINES.

THE UNITED STATES, FOR SOCIAL, ECONOMIC AND POLITICAL REASONS, HAS CHOSEN NOT TO COMPETE WITH THE SOVIET UNION IN QUANTITY OF MILITARY WEAPONS AND FORCES. INSTEAD THE UNITED STATES AND ITS ALLIES HAVE SOUGHT TO OFFSET THE SOVIET QUANTITATIVE ADVANTAGE THROUGH THE EXPLOITATION OF SUPERIOR TECHNOLOGY IN THEIR WEAPONRY. AS THE DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ADVANCED TECHNOLOGY, MY RESPONSIBILITY IS TO OVERSEE THE INVESTMENT OF NEARLY 5 BILLION DOLLARS ANNUALLY TO ASSURE THAT WE ARE NOT CAUGHT BY TECHNOLOGICAL SURPRISE AND THAT WE INDEED HAVE THAT SUPERIOR TECHNOLOGY. RECOGNIZING THAT IT IS NOT POSSIBLE TO PROTECT ANY GIVEN TECHNOLOGY FOREVER, U.S. POLICY MAKERS HAVE CONCLUDED THAT IT IS ESSENTIAL TO PROTECT TECHNOLOGICAL LEAD TIMES. I THINK EVERYONE HERE WILL AGREE THAT TO DO OTHERWISE WOULD BE IRRESPONSIBLE. IF THE U.S. IS TO HAVE A MARGIN OF SAFETY, IT IS SURELY EMBODIED IN THESE LEAD TIMES.

TO REMEDY THE DECLINING LEAD IN MILITARY TECHNOLOGIES, WE CAN INCREASE OUR EFFORTS TO ADVANCE TECHNOLOGY, OR WE CAN ATTEMPT TO SLOW DOWN THE FLOW OF MILITARILY USEFUL TECHNOLOGIES TO OUR POTENTIAL ADVERSARIES, OR WE CAN DO BOTH. IT SEEMS TO ME THAT

DOING BOTH IS NECESSARY TO INCREASE OUR TECHNOLOGY LEAD. OUR GOAL IN FINDING WAYS TO PROTECT OUR TECHNOLOGY HAS BEEN TO SEEK A BALANCE WHICH LIMITS ADVERSARY ACCESS TO OUR MILITARY TECHNOLOGIES AS MUCH AS POSSIBLE WHILE MAINTAINING THE ABILITY OF OUR NATION TO PERFORM THE RESEARCH THAT GAVE US THE TECHNOLOGICAL LEAD IN THE FIRST PLACE. THE LITMUS TEST OF REASONABLENESS IN ACHIEVING THAT BALANCE IS THE IMPACT ON U.S. TECHNICAL SUPERIORITY.

MOST OF THE BASIC RESEARCH IN SCIENCE AND ENGINEERING SUPPORTED BY THE DEPARTMENT OF DEFENSE IS PERFORMED IN UNIVERSITY CENTERS, WITH RESEARCH WORKERS COMPETING AND VYING WITH ONE ANOTHER TO BE THE FIRST TO DISCOVER AND THE FASTEST TO APPLY THEIR FINDINGS. IN LARGE MEASURE, THIS IS THE WAY RESPECT IS GAINED FROM THEIR PEERS. OUR DEFENSES ARE STRONGER AND OUR NATION STANDS MORE SECURE BECAUSE OF THE EXCITING DISCOVERIES MADE BY THESE INQUIRING MINDS SEARCHING FOR NEW KNOWLEDGE AND UNDERSTANDING OF NATURAL PHENOMENA AND THEIR PRACTICAL APPLICATIONS

THE WORLD OF SCIENCE IS INTERNATIONAL IN CHARACTER. AMERICAN RESEARCHERS MEET AND INTERACT WITH THE BEST RESEARCHERS FROM OTHER NATIONS. EXCHANGING IDEAS AND INFORMATION, SO THAT EVERYONE BENEFITS. OUR UNIVERSITY SYSTEM, MADE STRONGER BY SUCH INTERACTIONS, IS THE ENVY OF THE WORLD.

UNTIL RECENTLY, THE CONDUCT OF RESEARCH IN THE UNIVERSITIES HAD NOT CAUSED SIGNIFICANT CONCERN WITH RESPECT TO THE HANDLING OF

DEFENSE INFORMATION. MOST RESEARCH, EVEN THAT WHICH HAS BEEN FUNDED BY DOD, IS UNCLASSIFIED. MOST OF THE CLASSIFIED RESEARCH PERFORMED BY UNIVERSITIES IS CONDUCTED IN "OFF-CAMPUS" INSTITUTIONS WHICH, ALTHOUGH AFFILIATED WITH A UNIVERSITY, ARE NONETHELESS SEPARATE ENOUGH SO THAT STRICT SECURITY PROCEDURES CAN BE EMPLOYED.

MORE RECENTLY THE SITUATION HAS BEEN COMPLICATED BY OTHER TRENDS AND CHANGES: (1) THE 1976 BUCY REPORT, "AN ANALYSIS OF EXPORT CONTROL OF U.S. TECHNOLOGY - A DOD PERSPECTIVE," MOVED THE FOCUS OF EXPORT CONTROLS FROM GOODS TO THE TECHNOLOGY USED TO PRODUCE THOSE GOODS, (2) IT SEEMS THAT SOME AMERICAN UNIVERSITIES ARE BECOMING MORE AND MORE INVOLVED IN APPLIED AND MANUFACTURING TECHNOLOGIES, E.G., MICROELECTRONICS, AND (3) IT IS BECOMING MORE AND MORE DIFFICULT TO DISTINGUISH BETWEEN MILITARY AND COMMERCIAL TECHNOLOGIES (E.G., COMPUTERS, ADVANCED MATERIALS, ETC.)

THERE IS NO DOUBT THAT UNIVERSITIES HAVE CONTRIBUTED GREATLY TO OUR NATIONAL SECURITY. THE CLASSIFIED WORK ON RADAR AT THE RADIO RESEARCH LABORATORY AT HARVARD AND THE RADIATION LABORATORY AT M.I.T. SAVED THE LIVES OF THOUSANDS AND WAS OF INCALCULABLE HELP IN WINNING WW II. DOPPLER SOUND TECHNIQUES DEVELOPED AT THE GEORGIA INSTITUTE OF TECHNOLOGY ARE BEING USED TO DETECT SUBMARINES AND TO MAKE OUR SEAS SAFER. THE LIST IS VIRTUALLY ENDLESS. OUR UNIVERSITIES CONDUCT MUCH OF THE RESEARCH IN LASERS,

COMPOSITE MATERIALS, AND MICROELECTRONIC CIRCUITRY THAT ARE NEEDED FOR OUR SOPHISTICATED NEW WEAPONS.

THE BENEFITS OF RESEARCH DEFY SIMPLE CATEGORIZATION INTO MILITARY, COMMERCIAL OR SCIENTIFIC. RADAR CONTINUES TO HELP MAKE COMMERCIAL AIR TRANSPORTATION SAFE. DOPPLER SOUND DETECTION IS BEING USED INSTEAD OF SURGERY TO LOCATE CIRCULATORY PROBLEMS IN PREMATURE BABIES. LASERS ARE FINDING HUNDREDS OF APPLICATIONS IN MEDICINE, INDUSTRY AND RESEARCH. THERE IS EVERY REASON TO BELIEVE THAT SUCH SPINOFFS, MILITARY TO COMMERCIAL AND VICE VERSA, WILL CONTINUE IN THE FUTURE. IN THE CASE OF BASIC SCIENTIFIC RESEARCH, WE CANNOT ALWAYS PREDICT WHERE IT WILL LEAD OR BE APPLIED.

THE IMPORTANCE OF UNIVERSITIES AS MAJOR PERFORMERS IN DEFENSE RESEARCH AND DEVELOPMENT IS GROWING. ABOUT HALF OF ALL DEFENSE BASIC RESEARCH FUNDS (BUDGET CATEGORY 6.1) ARE SPENT IN UNIVERSITIES, OVER $400M IN FY 1984. DOD RELIES UPON AND FOSTERS UNIVERSITY BASIC RESEARCH AND ENCOURAGES DISSEMINATION OF RESEARCH RESULTS THROUGHOUT THE WORLD SCIENTIFIC COMMUNITY IN ORDER TO MAXIMIZE THE BENEFITS OF OUR INVESTMENT. IN ADDITION, ABOUT $500 MILLION WILL BE SPENT IN UNIVERSITIES ON APPLIED RESEARCH AND DEVELOPMENT, WITH JUST OVER $400 MILLION GOING TO TWO LARGE RESEARCH CENTERS. THESE FACILITIES ARE LOCATED OFF-CAMPUS AND PERFORM BOTH CLASSIFIED AND UNCLASSIFIED WORK FOR DOD. IN THE CASE OF CLASSIFIED WORK, GREAT CAUTION IS OBVIOUSLY EXERCISED IN THE DISSEMINATION OF THE INFORMATION GENERATED. ONLY A SMALL PORTION OF THE UNCLASSIFIED WORK AT UNIVERSITIES IS APPLIED R&D THAT SHOULD BE REVIEWED FOR MILITARY CONCERNS.

IT IS OUR SINCERE BELIEF THAT TECHNOLOGY CANNOT BE PROTECTED WITHOUT THE COOPERATION OF THE TECHNOLOGISTS. OPEN, FRANK AND CONTINUING DIALOGUE ON THIS TOPIC IS AN ABSOLUTE NECESSITY FOR MUTUAL UNDERSTANDING. WE HAVE ATTEMPTED TO PROVIDE THE OPPORTUNITY FOR CONTINUED DISCOURSE BY MAKING THE DOD-UNIVERSITY FORUM, ALONG WITH ITS VARIOUS WORKING GROUPS, AN OFFICIAL ADVISORY BODY TO DOD.

LET ME SAY A FEW WORDS ABOUT THE DOD-UNIVERSITY FORUM. IT IS A GROUP OF 21 INDIVIDUALS DRAWN ALMOST EQUALLY FROM THE DOD AND THE UNIVERSITY RESEARCH COMMUNITY WHO MEET TWICE YEARLY TO DISCUSS MATTERS OF MUTUAL INTEREST TO DOD AND ACADEMIA. THE FORUM IS CO-CHAIRED BY THE USDRE, DR. RICHARD DELAUER, AND DR. DONALD KENNEDY, PRESIDENT OF STANFORD UNIVERSITY. IT IS CO-SPONSORED BY DOD AND THREE MAJOR HIGHER EDUCATION ASSOCIATIONS: THE ASSOCIATION OF AMERICAN UNIVERSITIES, THE AMERICAN COUNCIL ON EDUCATION AND THE NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND GRANT COLLEGES.

SUPPORTING THE FORUM ARE THREE PRIMARY WORKING GROUPS ON (1) TECHNOLOGY EXPORT CONTROL, (2) FOREIGN LANGUAGES AND AREA STUDIES, AND (3) ENGINEERING AND SCIENCE EDUCATION. THE ORGANIZATIONAL STRUCTURE OF THESE WORKING GROUPS MIRRORS THE FORUM STRUCTURE, WITH MEMBERSHIP IN EACH DRAWN EQUALLY FROM DOD AND THE UNIVERSITIES. EACH WORKING GROUP HAS ONE DOD AND ONE UNIVERSITY CO-CHAIR.

THE FORUM WAS CREATED TWO YEARS AGO BASED ON RECOMMENDATIONS MADE BY A DEFENSE SCIENCE BOARD STUDY ON UNIVERSITY RESPONSIVENESS WHICH SUGGESTED THAT A GROUP BE FORMED TO ENCOURAGE GREATER INTERACTION BETWEEN DOD AND THE UNIVERSITY COMMUNITY. IT WAS RECENTLY CHARTERED AS A FORMAL ADVISORY BODY TO THE DEPARTMENT OF DEFENSE.

THE FORUM, THROUGH ITS WORKING GROUP ON EXPORT CONTROLS, HAS PARTICIPATED IN REVIEWING TECHNOLOGY TRANSFER POLICIES BEING CONSIDERED BY THE DEPARTMENT AS THEY EVOLVED. THAT INTERACTION WAS INVALUABLE. IT INSURED THAT DOD PROPOSALS WERE UNDERSTOOD AND THAT THE POLICIES TOOK ACCOUNT OF ALL POSITIONS. AS A RESULT OF A GENUINE WILL TO COOPERATE, AND OF OPENNESS AND CANDOR, A SIGNIFICANT LEVEL OF AGREEMENT WAS REACHED BETWEEN THE ACADEMIC AND GOVERNMENT COMMUNITIES DURING THE PAST YEAR. THOSE WHO PARTICIPATED IN THE PROCESS CAN TESTIFY TO THE EFFECTIVENESS OF THE EXCHANGES. ALTHOUGH NOT EVERY PROBLEM HAS BEEN SOLVED, ACTIVE, CONSTRUCTIVE, AND FRIENDLY DISCUSSION CONTINUES. IT IS THE INTENTION OF THE DOD TO CONTINUE WORKING WITH THE ACADEMIC COMMUNITY THROUGH THE DOD-UNIVERSITY FORUM AND TO ENCOURAGE PARTICIPATION IN THAT PROCESS.

THE RESPONSIBILITY FOR POLICY AND IMPLEMENTATION RESTS, OF COURSE, WITH THE DOD. ITS TASK WILL BE MUCH EASIER IF A CONSENSUS CAN FIRST BE ESTABLISHED AMONG UNIVERSITY AND DEFENSE DEPARTMENT SCIENTISTS AND ENGINEERS THROUGH CONVERSATIONS AT THE FORUM.

WITHIN THE DOD, A MAJOR ACCOMPLISHMENT FOR THE UNIVERSITY AND RESEARCH COMMUNITY RESULTED FROM THE WORK OF THE DOD AD HOC STEERING COMMITTEE ON NATIONAL SECURITY AND TECHNOLOGY TRANSFER. THANKS TO THE CONTRIBUTIONS OF MANY WITHIN DOD, RESEARCH AND DEVELOPMENT IS NOW GIVEN SEPARATE CONSIDERATION IN THE CONTEXT OF EXPORT CONTROL POLICY. IT LED TO A MAJOR REVISION OF A DOD DIRECTIVE AND THE SETTING UP OF A NEW PANEL FOR R&D.

THE NEW DOD DIRECTIVE IS NUMBERED 2040.2 AND TITLED "INTERNATIONAL TRANSFERS OF TECHNOLOGY, GOODS, SERVICES AND MUNITIONS." IT WAS SIGNED BY THE SECRETARY OF DEFENSE ON JANUARY 17, 1984. IT PROVIDES THE NECESSARY FOCUSED AND BALANCED APPROACH TO THE TECHNOLOGY TRANSFER ISSUES BY INVOLVING ALL THE INTERESTED PARTIES WITHIN DOD IN THE PROCESS. THE PANELS SET UP BY DOD DIRECTIVE 2040.2 PROVIDE A COORDINATION MECHANISM WITHIN DOD, JUST AS THE DOD-UNIVERSITY FORUM PROVIDES A COORDINATION MECHANISM BETWEEN DOD AND THE UNIVERSITIES.

THE NEW DIRECTIVE, IN ADDITION TO ASSIGNING TECHNOLOGY TRANSFER RESPONSIBILITIES WITHIN THE OFFICE OF THE SECRETARY OF DEFENSE, ESTABLISHES THE DOD INTERNATIONAL TECHNOLOGY TRANSFER (IT^2) PANEL AND TWO SUBPANELS (A AND B).

THE DOD IT^2 PANEL WILL IDENTIFY AND RESOLVE TECHNOLOGY TRANSFER POLICY ISSUES. IT IS CHAIRED BY THE ASSISTANT SECRETARY OF DEFENSE (INTERNATIONAL SECURITY POLICY), AND VICE-CHAIRED BY THE ASSISTANT SECRETARY OF DEFENSE (DEVELOPMENT AND SUPPORT).

THE DOD IT^2 SUBPANEL A ON EXPORT CONTROL POLICY WILL RESOLVE DOD DIFFERENCES ON MATTERS REFERRED TO IT CONCERNING THE TRANSFER OF TECHNOLOGY, GOODS, SERVICES AND MUNITIONS, IT IS CHAIRED BY THE DEPUTY ASSISTANT SECRETARY OF DEFENSE (INTERNATIONAL ECONOMIC TRADE AND SECURITY POLICY), AND VICE-CHAIRED BY THE DEPUTY UNDER SECRETARY OF DEFENSE (INTERNATIONAL PROGRAMS AND TECHNOLOGY).

THE DOD IT^2 SUBPANEL B ON RESEARCH AND DEVELOPMENT WILL RESOLVE DOD DIFFERENCES REGARDING TECHNICAL STANDARDS AND DEFINITIONS AND THE DISSEMINATION AND EXCHANGE OF INFORMATION. IT IS CHAIRED BY ME AND THE DEPUTY ASSISTANT SECRETARY OF DEFENSE (INTERNATIONAL ECONOMIC TRADE AND SECURITY POLICY).

SUBPANEL B WAS ESTABLISHED THIS YEAR, AND FIRST MET ON MARCH 22, 1984. ITS MEMBERSHIP INCLUDES REPRESENTATIVES OF THE MAJOR R&D ORGANIZATIONS IN THE DOD, IN CONTRAST TO SUBPANEL A, WHICH CONSISTS OF POLICY AND INTELLIGENCE REPRESENTATIVES. THIS INITIATIVE WAS OFFICIAL RECOGNITION THAT TECHNOLOGY CONTROL POLICIES CANNOT BE EFFECTIVE WITHOUT THE STRONG AND ACTIVE PARTICIPATION OF TECHNOLOGISTS.

AS INDICATED PREVIOUSLY, THE WAY FOR SUBPANEL B WAS PREPARED BY THE STEERING COMMITTEE ON NATIONAL SECURITY AND TECHNOLOGY

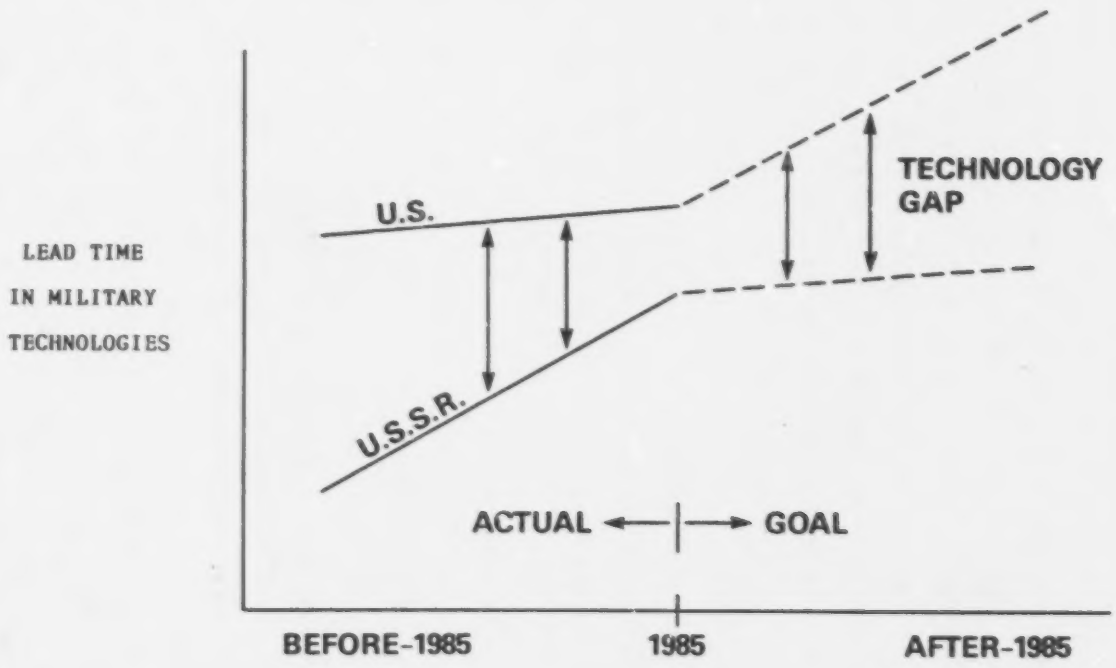
TRANSFER WHICH I CHAIRED THROUGHOUT 1983. THE STEERING COMMITTEE HELD SIX MEETINGS IN 1983 AND ESTABLISHED SEVEN WORKING GROUPS UNDER IT. STEERING COMMITTEE FINDINGS REINFORCED THE R&D POINT OF VIEW, WHICH INSISTS THAT "SECURITY BY ACCOMPLISHMENT" CANNOT BE LEFT OUT OF TECHNOLOGY TRANSFER CONSIDERATIONS. THE FUNCTIONS OF THE STEERING COMMITTEE HAVE NOW BEEN TRANSFERRED TO SUBPANEL B ON RESEARCH AND DEVELOPMENT, WHICH WILL WORK WITH THE DOD-UNIVERSITY FORUM ON EXPORT CONTROLS. THE COORDINATION WILL BE FACILITATED BY THE FACT THAT I CHAIR THE FORMER AND CO-CHAIR THE LATTER.

WE ARE ENCOURAGED BY THIS RECOGNITION THROUGH DOD DIRECTIVE 2040.2 OF THE IMPORTANCE OF SCIENCE AND TECHNOLOGY, OF ITS DISTINCT CHARACTER AS COMPARED TO ACQUISITION, AND FEEL RECOGNITION REPRESENTS A COMMITMENT ON THE PART OF ALL COMPONENTS OF THE DOD.

THESE THREE PANELS UNDER DOD DIRECTIVE 2040.2 BRING TOGETHER ALL THE INVOLVED OFFICES AND INTERESTS (INCLUDING RESEARCH) WITHIN DOD, AND WILL ENSURE A GOOD EXCHANGE OF VIEWS BEFORE MODIFYING A TECHNOLOGY TRANSFER SYSTEM WHICH IS GENERALLY WORKING VERY WELL.

MR. CHAIRMAN, WE APPRECIATE THE OPPORTUNITY TO SHARE OUR CONCERNS WITH YOUR COMMITTEE, AND WELCOME YOUR COOPERATION AS WE

STRIVE TO INCREASE OUR KNOWLEDGE BASE, STRENGTHEN AND ASSIST OUR UNIVERSITIES, AND ACCELERATE OUR TECHNOLOGICAL PROGRESS. THIS WAS INDICATED BY THE UPPER CURVE ON THE CHART I SHOWED AT THE BEGINNING OF MY TALK. AT THE SAME TIME WE MUST FULFILL DOD'S MISSION BY KEEPING OUR OWN TECHNOLOGICAL CAPABILITY WELL ABOVE THAT OF OUR ADVERSARIES. WE CANNOT AFFORD TO GRATUITOUSLY BUILD UP AN ENEMY'S MILITARY OR MANUFACTURING TECHNOLOGY BASE WHICH MIGHT ONE DAY BE USED TO DAMAGE OR DESTROY OUR NATION. I BELIEVE WE HAVE MADE MUCH HEADWAY IN THE PAST 12 MONTHS THANKS TO ASSISTANCE SO GENEROUSLY PROVIDED BY MANY PUBLIC SPIRITED INDIVIDUALS. I AM CONFIDENT THAT WE SHALL CONTINUE TO MAKE EXCELLENT PROGRESS IN THE FUTURE.


LEAD TIME
IN MILITARY
TECHNOLOGIES
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TECHNOLOGY
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AFTER-1985

3158-4

DR. EDITH W. MARTIN

Dr. Edith W. Martin is Deputy Under Secretary of Defense for Research and Advanced Technology in the Department of Defense. She was formerly a Corporate Executive with Control Data Corporation, and Director of Government Systems, Atlanta Operations. Frior to that position, Dr. Martin was Director of the Computer Science and Technology Laboratory at Georgia Tech's Engineering Experiment Station. In both of these positions she was involved in Defense-related research and development activities. Dr. Martin currently serves as the top U.S./defense official providing policy, guidance, and oversight for U.S. defense science and technology. She is the principle U.S. representative to the NATO Defense Research Group and is NAMRAD principle to The Technical Cooperative Program with our allies.

Dr. Martin has been recognized for her leadership and contributions to the defense/industrial community via numerous awards, including several from the Electronics Industries Association, the American Defense Preparedness Association, Armed Forces Communications and Electronics Association, and the Institute for Electrical and Electronics Engineers. She has also served as a member of the Defense Science Board Special Task Force on Embedded Computer Resources, on the Editorial Review Board (Computer Science Expert) of Military Electronics Countermeasures, on the Editorial Board of IEEE Software Magazine, and as chairman of a large number of technical review committees. Dr. Martin's current initiatives in technologies

essential to military critical computer systems; export control and technology transfer; and science and engineering education have received strong support throughout the Department of Defense, the commercial sector and university communities. Her publications in computer science and almost the full spectrum of defense research are widely read and quoted.

Dr. Martin received her Ph.D and M.S. degrees in information and Computer Science from the Georgia Institute of Technology. She received a B.A. degree in Experimental Psychology from Lake Forest College, Illinois.

NATIONAL POLICY ON THE TRANSFER OF TECHNICAL INFORMATION

I. PURPOSE

This directive establishes national policy for controlling the flow of science and technology information produced in research at colleges, universities, and federal laboratories under contract to U.S. government agencies.

II. BACKGROUND

The acquisition of advanced technology from the United States by Eastern Bloc nations for the purpose of enhancing their military capabilities poses a significant threat to our national security. Intelligence studies indicate a small but significant target of the Eastern Bloc intelligence gathering effort is science and engineering research performed at universities and federal laboratories. At the same time, our leadership position in science and technology is an essential element in our economic and physical security. The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component.

In 1982, the Department of Defense and National Science Foundation sponsored a National Academy of Sciences study of the need for controls on scientific information. This study was chaired by Dr. Dale Corson, President Emeritus of Cornell University. It concluded that, while there has been a signficant transfer of U.S. technology to the Soviet Union, this transfer has occurred through many routes with universities and open scientific communication being a minor contributor. Yet as the emerging government-university-industry partnership continues to grow, a more significant problem may well develop.

III. POLICY STATEMENT

It is the policy of this administration that the mechanism for control of fundamental research in science and engineering at universities and federal laboratories is classification. Each federal government agency is responsible for: a) determining whether classification is appropriate prior to the award of a research grant or contract and, if so, controlling the research results through standard classification procedures; b) periodically reviewing all research grants or contracts for potential classification. No restrictions may be placed upon the conduct or reporting of research that has not received national security classification.

Mr. WALGREN. Thank you, Dr. Martin.

I understand that you have a time constraint and maybe we ought to at least talk a little bit about this before turning to the other witnesses, and then perhaps we can—

I want to say how much we appreciate that testimony, particularly the submission on what the national policy, the resolution of this debate has been within the administration.

When was that made, that we would—that the decision not to pursue the gray-area concept and instead to rely strictly on classification?

Dr. MARTIN. Well, those alternatives have been there from the very beginning. The proposal on the part of the Corson report was one that indicated that some small area that merited special attention should not be classified, but on the other hand should not be made freely available to our potential adversaries. So, you know, in the background was always the possibility of going to strictly a classification-nonclassification approach.

As we emerged—Well, when I initially took on this endeavor, which was in January 1983, our intent at that time was to have a set of policies and procedures to implement the intent of the Corson report within 3 to 4 months. A year later, after a tremendous amount of work on the part of an awful lot of people, it became very clear that the topic was considerably more complicated than we at first surmised. We found that the tradeoffs were very unclear and that the difficulties in administering any proposed set of procedures were quite burdensome and, in fact, we might have done better by applying the same resources to running faster rather than trying to be protective.

So I truly feel that the conclusion we came to was one that was evolving over time, as we put in the effort and found that we were not coming closer to a satisfactory resolution. As I stated in my testimony, my job is to move the United States forward. Naturally, one cannot do that in a cavalier manner and one cannot be irresponsible about it. So it is important that as we look at how we make that $5 billion a year investment, we also make sure that we are not giving that investment away. The decision that we came to is one that is wrought out of true, deep, and sincere deliberation——

Mr. WALGREN. That's a relatively recent decision, is it not?

Dr. MARTIN. It is only recent in terms of it being enunciated publicly, but it has been in discussion for probably more than 3 months.

As we passed the year mark, it became clear that we could spend another year and not come any closer to having a totally satisfactory conclusion to this matter. Expedience is important.

Mr. WALGREN. When was it publicly disclosed that the agency or the Department had decided on this approach as a matter of national policy?

Dr. MARTIN. Congratulations. You are it. [Laughter.]

This is a draft policy. As I said, within Government, it is in the process of being coordinated between—OSTP and the Department of Defense are in agreement with this policy. There may be a few word changes, but I sincerely doubt you will see anything significantly different in its final version.

Mr. WALGREN. Well, I appreciate that. Certainly, at least there is a certain clarity in it that I think will give a lot of people reassurance that there will be workable understandings that they can at least see in advance and take account of and proceed accordingly.

Dr. MARTIN. I think there are two very significant accomplishments that should be highlighted. One is the recognition of R&D as something different than acquisition as relates to technical information. The other is this very clear statement that there is and has been no intent for control of that fundamental research information.

I might say that the reason that it has even come up as a question is simply a testimony to the sophistication and advancement of not just other countries but potential adversaries and their ability to take theory and concepts and translate theory and concepts into real systems. That is a change that has come about in the last 15 years. So, you know, this consideration is one that is important and should be revisited from time to time, because the world in which we must operate is a changing world, so hopefully you will take it upon yourselves to stay abreast of that world situation and look from time to time to the viability of the policies that are in place.

Mr. WALGREN. And this is a national policy; it is not just limited to the Department of Defense?

Dr. MARTIN. It will be an administration policy, yes, sir.

Mr. WALGREN. The Chair would like to recognize Mr. Glickman.

Mr. GLICKMAN. Could you, Dr. Martin, again clarify this change in policy having to do with restrictions on academic research, whether it is also applicable to research on work by industry, and how it would affect the proposed regulations in the March 30, 1984, Federal Register, which include processes as well as commodities for control.

Dr. MARTIN. I think that it is very important that we separate the research activities and products or commodities, because they are dealt with totally separately as of the signing of DOD Directive 2040.2. The policy that is stated here refers to research, whether it takes place in a university or it takes place in industry. But it is not a policy that pertains to equipment or commodities or manufacturing.

Mr. GLICKMAN. So it is clear, though, that the policy does apply to research, for both academic research and industrial research so to speak?

Dr. MARTIN. That's correct.

Mr. GLICKMAN. I just make the point that, since processing is at the heart of all advanced materials research, there is literally no program grant or materials research activity that would not be potentially covered by restrictive regulations. I wonder how you respond to that.

Dr. MARTIN. I think—well, that's a very, you know—it's such a broad, sweeping statement, it is very hard to respond to that. You know, certainly——

Mr. GLICKMAN. That's because the regulations are so broad, though, that I make a broad statement in response.

Dr. MARTIN. Well, if you're saying that everything we use is made up of some sort of materials, or anything that affects materials affects everything we use, I can't deny that.

Mr. GLICKMAN. I guess my question is, do you include processes just in the regulation to make it all the more restrictive, so that almost everything is precluded from export?

Dr. MARTIN. All right. Let me say that we are not in this policy referring to those things related to production and manufacturing. As we talk about research, we are talking about fundamental research, and we are not talking about applied research that one would find in the near product——

Mr. GLICKMAN. How do you make the distinction?

Dr. MARTIN [continuing]. Stages.

Well, in fundamental research, it is a scientific endeavor that expands our basic knowledge and understanding of the world and the universe. In applied research, we have taken that understanding and given it some specific use or meaning.

Mr. GLICKMAN. Well, I hope that there are some standards that are open so the public will understand how those distinctions are made.

Dr. MARTIN. I am quite sure that as much clarity as possible will be embodied in that policy.

Mr. GLICKMAN. If you might raise that chart again, I must tell you, Dr. Martin, that's a disturbing chart. First off it——

Dr. MARTIN. Yes, it is.

Mr. GLICKMAN. In the first place, it is disturbing because it is the most unscientific chart I have ever seen. There are no numbers on the left-hand side. I don't know what your——

Dr. MARTIN. Would you like me to put some numbers there?

Mr. GLICKMAN. I mean, I would think that the lead time would have to have—I mean, I assume that you've got some quantifiable statistics there——

Dr. MARTIN. Uh-huh.

Mr. GLICKMAN [continuing]. Showing what the leadtime is going to be.

Dr. MARTIN. But the lead time will vary by specific technical area. This is an attempt to give you the general trend as opposed to the specifics of any one technology. But it varies from technology to technology.

Mr. GLICKMAN. The other side of the coin is, you show this technology gap broadening between the United States and the U.S.S.R.

Dr. MARTIN. No, that's our desire.

Mr. GLICKMAN. Yeah. Maybe your desire ought to be that the gap ought to be pretty much like the arms control race. You know, if we want to get superiority with the Russians, it will never happen because they're not going to sit down and allow us to get superiority. Maybe—I would like to be ahead of them, but I would like those lines to be parallel because I can just see an arms race in technology developing if we try to broaden that thing into——

Dr. MARTIN. That's a somewhat political and somewhat philosophical discourse there. But as long as we have the blue line and they have the red line, that's OK with me.

Mr. GLICKMAN. Well, yes. What a way to make defense policy, we have the blue line and they have the red line. [Laughter.]

Dr. MARTIN. Being that the blue line is obviously much higher than the red line.

Mr. GLICKMAN. We're going to have to go and vote, and I am concerned about the impact of the proposed export regulations on such programs as the advanced gas turbine program or the new advanced materials program. I wonder if you have accessed the impact of the proposed export regulations on those and if you could get us something in writing to indicate how you think they would be impacted, if possible.

Dr. MARTIN. Yes, I would be glad to do that. And as far as the new export administration regulations go, I do have my concerns about that and what it will do to our aspirations in widening that gap, or at least making sure that the gap remains parallel.

I have a concern that that policy may be very specific about things that we are doing and that—let's say as it refers to the MCTL, it does something with the MCTL that we in the Department of Defense had never hoped or intended, and that is that it makes the MCTL ex post facto a control list, which the MCTL is not, nor should it be.

So I have concern with the act as it relates——

Mr. GLICKMAN. And the Department of Energy also I think has concerns as well. I am very concerned about the impact of these regulations on programs like the advanced materials program and the advanced gas turbine program. I want to relate that to you and I would like for you to assess it and I would like DOE to assess it.

One final question. I have a Science magazine article of May 4, 1984, that seems to indicate there is some dissent within the Department of Defense on some of these issues we have been raising between you and Dr. DeLauer, perhaps between Dr. DeLauer and Mr. Richard Perle and others who may have different goals, different ideological and philosophical inclinations in this regard.

What are Dr. DeLauer's feelings on the question of "DOD censorship," some of the issues we have talked about today?

Dr. MARTIN. Dr. DeLauer and I are 100 percent in sync on the issues related to export control, and in the matters that are both under my purview and as it so happens in matters that are not. What came about as an apparent disagreement in the meeting referred to by that article in Science happened to have been a divulgence on Dr. DeLauer's part of the thinking that was in the back of our minds, as I said for some 3 to 4 months, concerning the possibility of going to strictly a classified-nonclassified approach if we were not going to be successful in finding a way to manage the Corson grey areas.

Mr. GLICKMAN. Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Glickman.

I gather that you are now prepared to respond to Dr. Gray's letter that was sent by the several presidents of the universities?

Dr. MARTIN. Dr. Gray's letter was sent to Dr. DeLauer and the answering of that letter I shall leave to Dr. DeLauer, but I think that the issue is totally resolved between them.

Mr. WALGREN. I don't know much about how you go about classifying things. You say in the release that each Federal Government agency will be responsible for determining whether classification is appropriate, so that apparently will fall back then to decisions within each agency and how they contract their research dollars,

and these are limited, as I understand it, to relationships that that agency is taking initiative to enter into.

Dr. MARTIN. Correct.

Mr. WALGREN. So we're no longer talking about any kind of more broadly——

Dr. MARTIN. Classification is determined on a project-by-project basis, and the level of classification is determined on the severity of the loss of that information to the security of the United States. It is not something that can be misused or abused without it being subject to criminal punishment. So I think that we can feel fairly secure in the very strict adherence on the part of the users of that tool to use it as conscientiously as possible.

Mr. WALGREN. Do these lists that have been mentioned, the militarily significant emerging technologies awareness lists and the others, do they have standing with respect to classification at this point of any particular kind?

Dr. MARTIN. No. They do not, nor was it ever intended that they would.

Mr. WALGREN. I wonder whether we have a copy of the graph for submission for the record.

Dr. MARTIN. I believe that you do, but I will make sure before I leave that a staffer has that in hand.

Mr. WALGREN. There is some indication that it might already be in your statement, and we certainly want it there.

What is the data behind that graph again?

Dr. MARTIN. That is an aggregate of information that we have within the Department of Defense and from our various intelligence sources.

Mr. WALGREN. And what are the parameters of the graph? Are they dollars?

Dr. MARTIN. Actually, it can be—The same trend curves can be used in two ways. One is technical lead time, so that's the parameter—obviously, United States versus the United Soviet Socialist Republic over years. The other interpretation that would equally apply is capability.

Mr. WALGREN. How are those judgments quantified so they can be displayed on a graph? How do you display technical lead time? Is that an aggregate of known——

Dr. MARTIN. Yes.

Mr. WALGREN. Lead times in certain technologies?

Dr. MARTIN. Correct.

Say if we take our status in technology X, and our belief of when we would see that technology reach the same point in the Soviet Union, the difference between those two numbers is reflected in that chart.

Mr. WALGREN. And that then is an assessment of when we believe, that that's a relatively subjective——

Dr. MARTIN. It's a very dynamic situation. Do not underestimate the sophistication of the Soviet Union. Do not underestimate the speed with which that gap can be closed when they are graduating 300,000 engineers every year and we are graduating 60. If we want to do something for the United States of America, we should be increasing our technological reservoir.

Mr. WALGREN. Whose assessment would that be, what personnel? Is that the Department of Defense's intelligence estimates that go into that assessment?

Dr. MARTIN. Correct—well, intelligence information and technical evaluation. As was just indicated, that is reflected in the Secretary of Defense's statement.

Mr. WALGREN. Well, we want to thank you very much. I have to break now and I know you have to leave. I apologize to the gentlemen who are sort of on the end of this at this point.

Mr. ARCHEY. I have a meeting with some foreign visitors scheduled for about 2 months at 2 o'clock that I have to be at.

Mr. WALGREN. At what time?

Mr. ARCHEY. At 2 o'clock, at the Commerce Department.

Mr. WALGREN. Could you give us 15 more minutes? Could you get there in that time?

Mr. ARCHEY. I could.

Mr. WALGREN. OK. Let's recess then for that time and I think I can promise to get you out of here. We will certainly do it.

[Whereupon, the subcommittees were in recess.]

Mr. WALGREN. We will now turn to Mr. Archey at this point. I apologize for this having gone on. I just want to give you a chance to summarize your statement. It will, of course, be printed, as you know, in full form. But I would like to hear just a couple of summary points, if you like, and then be pleased to release you.

Mr. ARCHEY. My statement, Mr. Chairman, is quite brief, but I think I would rather do a summary to begin with.

Really, the fundamental role of the Commerce Department is the implementation of the technical data regulations, the actual development and implementation of them, namely how the Militarily Critical Technology List is actually implemented in the regulations, so I would like to address that directly because that really is within the purview of the Commerce Department.

The Militarily Critical Technology List is a response to the 1976 Bucy Report, which maintained that control of design and manufacturing know-how was absolutely vital to the maintenance of technological superiority over the bloc.

The traditional controls used by Cocom were commodity oriented, although the technology specific to the controlled commodity was also controlled.

The MCTL is a listing of the total technology used for the design and manufacturing of commodities as well as the commodities themselves used by the Department of Defense. In each of the 18 areas of the MCTL identified by DOD as being of concern, four elements are discussed. They are: keystone materials, keystone equipment, goods accompanied by sophisticated know-how, and lastly, arrays of know-how. For MCTL purposes, arrays of know-how is defined as follows:

> The interrelated collection and organization of services, processes, procedures, specifications, data, criteria and training aids and/or instructions which individually may or may not be significant but because of their mutual effect on each other must be specified and mastered as a group to achieve a significant development, production, or utilization purpose.

Parts (A) through (D) may be considered to be the total technology related to an item, while part (D), by itself, will be referred to as technical data.

Items (A), (B), and (C), namely, keystone materials, keystone equipment, and goods accompanied by sophisticated know-how, are commodity oriented and fall naturally into the traditional list review which we conduct with our Cocom allies. Seventy-five percent of the 1981 version of the MCTL was included in our proposals recently submitted by the State Department to Cocom for the every-3-year list review. About 100 change proposal entries were submitted by the United States in June 1982. Because of the influence of the MCTL, two-thirds of the U.S. proposals were for tightening of control. Negotiations on the U.S. proposals, as well as those of other member countries, are currently in Round Two of the list review ongoing in Paris presently, and it is anticipated that 80 to 90 pecent of the proposals will be resolved by the end of the list review, probably later this summer. Thus, by late this summer or early this fall we will have implemented most of the MCTL in terms of the specific pieces of keystone equpiment and keystone materials.

What remains to be done, however, is the part of the MCTL that has largely not been addressed, which is the arrays of know-how, also referred to, as I stated, as technical data. Although specific arrays of know-how for semiconductors were completed in time to be included in the Cocom list review, we did not include them in the proposals because the new approach on a primarily technology-oriented basis would prove difficult to negotiate and would forestall agreements on the major traditional commodity items.

Our program to incorporate the MCTL arrays of know-how or technical data is called the MCTL Implementation Program. It is Commerce's intent to define the arrays of know-how in all 18 areas, not just semiconductors, with sufficient specificity so that they may be included in the Export Administration Regulations, and to rewrite the regulatory language in the Export Administration Regulations so as to better control critical technical data transfers to the Warsaw Pact. Currently, such data is controlled to the Eastern bloc but is largely uncontrolled to the West.

The Department of Commerce has recently initiated a major effort to incorporate the Militarily Critical Technology List into its regulations. We are now organizing to bring in experts from government, industry and academia to make recommendations for changes in language and in the format. These are organized around our own technical advisory committees. The Department's objective is to publish proposed changes to the regs implementing the technical data portion as early as April 1985.

Should the new Export Administration Act the one that is in conference presently, pass, it has in it a requirement that we, in fact, publish the technical data regulations for the Militarily Critical Technology List by April 1985.

In conclusion, I have tried to sketch out the Department of Commerce's role with respect to implementing the MCTL with respect to arrays of know-how. Much remains to be done in terms of defining the specific critical technologies that will be covered. We frankly share the Corson report's view that we can maximize the national security benefits of technical data controls by building high fences around narrow areas.

The original MCTL was a comprehensive listing, comprising over 700 pages in a classified form of militarily critical technologies. We have a formidable task in reducing this list to a more narrowly defined unclassified listing for control purposes. We must effectively protect the really significant technologies without unduly hampering world trade or restricting the flow of scientific communications that is not only vital but absolutely essential to the health of our academic community and to the tenets of our free society. In short, we face an operational question of some considerable import, that is, how do we translate rather broad generic categories of critical technologies included in the MCTL into specific detailed items for control purposes.

I would just like to add another couple of points that are not in my prepared statement. I am not sure the General Electric Co. would appreciate my saying this, but I would submit to you, Mr. Chairman, that the Commerce Department could endorse almost all of Dr. Schmitt's testimony in terms of the approach to dealing with the MCTL. I think the point that Dr. Schmitt makes is, first and foremost, we have got to define technologies that are truly critical, militarily critical, and not just technologies that are useful or that are important. We think a lot more needs to be done in doing that.

The second issue that does not receive a great deal of attention is the question of how will those controls be affected going West. Should we control technology going to a country that has that technology already, and having that technology, does a very good job of controlling it itself to the Warsaw Pact? We seriously question whether we should do that.

The third point that I think is a very important one, and has not been finalized, which is the question of the foreign availability in general of certain technologies not controlled to the Warsaw Pact, and the question of whether or not, through bilateral negotiations, we are able to convince a country that that technology should no longer be made available. If we are not capable of convincing that country, a serious question should be raised as to whether that technology should be controlled, whether militarily useful or not, if in fact, it is freely available to the Warsaw Pact.

The last point is that we have to be very careful in the translation of what is now a classified document into a document that ultimately has to become not only a public document but becomes the basis by which the business community, and other governments understand what the rules are that will prevail. It is very important that we be able to take generic technology categories and translate it in specific terms so that it is understandable.

Even if there is no disagreement with the fact that the general technology should be controlled, how that is stated in the regulations can become very important. We are working very hard to do that with the enormous involvement of the business community.

Given that, Mr. Chairman, that is a summary of my comments.

[The prepared statement of Mr. Archey follows:]

STATEMENT OF WILLIAM T. ARCHEY, ACTING ASSISTANT SECRETARY FOR TRADE ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

INTRODUCTION

THANK YOU FOR THIS OPPORTUNITY TO PRESENT THE DEPARTMENT OF COMMERCE'S VIEWS ON WHAT IS CERTAINLY ONE OF THE MOST COMPLEX AND VEXING POLICY QUESTIONS IN THE WHOLE TECHNOLOGY TRANSFER AREA--THE APPLICATION OF EXPORT CONTROLS TO INTERNATIONAL SCIENTIFIC COMMUNICATION AND NATIONAL SECURITY. I WOULD LIKE TO DESCRIBE THESE ISSUES FROM THE COMMERCE DEPARTMENT PERSPECTIVE, EMPHASIZING THE APPLICATIONS OF OUR CURRENT EXPORT CONTROLS AND THE GENERAL MANNER IN WHICH WE ARE PROCEEDING IN THIS DIFFICULT AREA TO IMPLEMENT THE MILITARILY CRITICAL TECHNOLOGIES LIST (MCTL) WITH RESPECT TO CONTROLLING TECHNICAL DATA.

TECHNOLOGY TRANSFER

AMONG THE TRANSFER OF TECHNOLOGY ISSUES OF CONCERN TO THIS ADMINISTRATION IS HOW AND WHEN TO PREVENT OR DELAY THE TRANSFER OF SENSITIVE, DUAL-USE TECHNOLOGY FOR NATIONAL SECURITY REASONS WITHOUT UNDULY BURDENING CREATIVE SCIENTIFIC RESEARCH OR SCIENTIFIC COMMUNICATION. THE COMPLEXITY OF THIS QUESTION STEMS FROM TRYING TO ASSURE THE PROPER BALANCE BETWEEN VITAL NATIONAL SECURITY INTERESTS AND THE INVALUABLE PROCESS OF SCIENTIFIC EXCHANGE. DURING ENACTMENT OF THE EXPORT ADMINISTRATION ACT OF 1979, THE HOUSE RECOGNIZED THIS COMPLEXITY. THE FOREIGN AFFAIRS COMMITTEE REPORT AT THAT TIME STATED THAT CONTROLLING THE TRANSFER OF TECHNOLOGY THROUGH SCIENTIFIC EXCHANGE IS "DIFFICULT, IF NOT IMPOSSIBLE."

THE FACT THAT THESE HEARINGS ARE BEING HELD TODAY REFLECTS THE SCIENTIFIC COMMUNITY'S CONTINUING CONCERN AND RECOGNITION OF THE LEGITIMATE AND NECESSARY ADMINISTRATION'S EFFORTS TO STEM THE TRANSFER OF SENSITIVE TECHNOLOGY TO POTENTIAL ADVERSARIES. THE DEPARTMENT OF COMMERCE IS WORKING HARD TO INSURE THAT OUR TECHNICAL DATA CONTROLS DO NOT STIFLE SCIENTIFIC EXCHANGE TO THE DETRIMENT OF U.S. SCIENTIFIC DEVELOPMENT NOR WILL IMPOSE UNWORKABLE CONSTRAINTS ON DAY-TO-DAY ACTIVITIES IN UNIVERSITIES.

I BELIEVE THE REPORT PREPARED BY THE PANEL ON SCIENTIFIC COMMUNICATION AND NATIONAL SECURITY, COMMITTEE ON SCIENCE, ENGINEERING AND PUBLIC POLICY OF THE NATIONAL ACADEMY OF SCIENCES--THE CORSON REPORT--SETS FORWARD THE CONCERNS OF THE SCIENTIFIC COMMUNITY. THAT REPORT WAS THOUGHTFUL AND HAS PROVIDED THE GOVERNMENT CONSIDERABLE FOOD FOR THOUGHT AS WE EXAMINE OUR CONTROLS ON TECHNICAL DATA AND SET A COURSE OF MCTL IMPLEMENTATION WITH RESPECT TECHNICAL DATA (I.E. INFORMATION FOR USE IN THE DESIGN, MANUFACTURE, UTILIZATION OR RECONSTRUCTION OF ARTICLES OR MATERIALS.)

MR. CHAIRMAN, WITH YOUR PERMISSION, I WISH TO FOCUS MY REMARKS THIS MORNING ON THE ISSUE OF THE DEPARTMENT OF COMMERCE'S ROLE IN IMPLEMENTING THE TECHNICAL DATA PORTION OF THE MCTL. I WILL NARROWLY CONCENTRATE ON THE ISSUE OF THE CONTROL OF CRITICAL TECHNICAL DATA FOR WHICH COMMERCE IS RESPONSIBLE. THIS RESPONSIBILITY RESTS WITH THE SECRETARY OF COMMERCE AS SET FORTH IN THE EXPORT ADMINISTRATION ACT (EAA) OF 1979. THE EAA PROVIDES THAT THE MCTL SHALL "BECOME A PART OF THE COMMODITY CONTROL LIST.

The MCTL

The Militarily Critical Technologies List is a response of the 1976 Bucy Report which maintained that control of design and manufacturing know-how was absolutely vital to the maintenance of technological superiority over the Bloc. The traditional controls used by COCOM were commodity oriented, although the technology specific to the controlled commodity was also controlled. The MCTL is a listing of the total technology used for the design and manufacturing of commodities, as well as the commodities themselves, used by the Department of Defense. In each of the eighteen areas identified by DOD as being of concern, four elements are discussed. They are (A) keystone materials, (B) keystone equipment, (C) goods accompanied by sophisticated know-how, and (D) arrays of know-how. For MCTL purposes arrays of know-how is defined as:

> "the interrelated collection and organization of services, processes, procedures, specifications, data, criteria, and training aids and/or instructions which individually may or may not be significant but because of their mutual effect on each other must be specified and mastered as a group to achieve a significant development, production, or utilization purpose". Parts (A) through (D) may be considered to be the total technology related to an item, while part (D) by itself will be referred to as "technical data".

Relation of MCTL to COCOM

Items (a), (b), and (c), above (but not (d)), are commodity oriented and fall naturally into the traditional List Review procedure. Thus, seventy-five percent of (the 198L version) the MCTL was included in the proposals submitted by the Technical Task Groups charted by the State Department in January 1982. About 100 change proposal entries were submitted by the U.S. in June 1982. Because of the influence of the MCTL, about two-thirds of the U.S. proposals were for tightening of control. Negotiations on the U.S. proposals, aswell as those of other Member Countries are currently in Round Two of the List Review and it is anitICipated that 80-90% of the proposals will have been resolved by the end of the List Review, which will occur later this summer. Thus, by later this summer or early this fall we will have "implemented" most of the MCTL.

What remains to be done

The part of the MCTL that has largely not been addressed is part (d), the arrays of know-how, also referred to as technical data. Although specific arrays of know-how for semiconductors were completed in time to be included in the List Review, we did not include them in the U.S. proposals because that new approach would prove difficult to negotiate and would forestall agreements on the traditional commodity items.

MCTL Implementation Program

Our program to incorporate the MCTL arrays of know-how (part (d)) is called the MCTL Implementation Program. It is Commerce's intent to define the arrays of know-how in the entire MCTL (all eighteen areas--not just semiconductors) with sufficient specificity so that they may be included in the Export Administration Regulations (EARs) and to rewrite the regulatory language in the EARs so as to better control critical technical data transfers to the Bloc. Currently, such data is controlled to the Bloc but is largely uncontrolled to the West.

The Department of Commerce has recently initiated a major effort to incorporate the MCTL into the EAR. We are now organizing to bring in experts from government, industry and academia to make recommendations for changes in language and format of the EAR. These are organized around our Technical Advisory Committees. The Department's objective is to publish proposed changes to the EAR implementing the technical data portion of the MCTL as early as April 1985.

CONCLUSION

I HAVE TRIED TO STRETCH THE CURRENT DEPARTMENT OF COMMERCE ROLE WITH RESPECT TO IMPLEMENTING THE MCTL WITH RESPECT TO "ARRAYS OF KNOW-HOW." MUCH REMAINS TO BE DONE IN TERMS OF DEFINING THE SPECIFIC CRITICAL TECHNOLOGIES TO BE COVERED. WE SHARE THE CORSON'S REPORT VIEW THAT WE CAN MAXIMIZE THE NATIONAL SECURITY BENEFITS OF TECHNICAL DATA CONTROLS BY "BUILDING HIGH FENCES AROUND NARROW AREAS."

THE ORIGINAL MCTL WAS A COMPREHENSIVE LISTING, COMPRISING OVER 700 PAGES IN CLASSIFIED FORM, OF MILITARILY CRITICAL TECHNOLOGIES. WE HAVE A FORMIDABLE TASK IN REDUCING THIS LIST TO A MORE NARROWLY DEFINED UNCLASSIFIED LISTING FOR CONTROL PURPOSES. WE MUST EFFECTIVELY PROTECT THE REALLY SIGNIFICANT TECHNOLOGIES WITHOUT UNDULY HAMPERING WORLD TRADE OR RESTRICTING THE FLOW OF SCIENTIFIC COMMUNICATIONS THAT IS NOT ONLY VITAL BUT ABSOLUTELY ESSENTIAL TO THE HEALTH OF OUR ACADEMIC COMMUNITY AND TO THE TENETS OF OUR FREE SOCIETY. IN SHORT, WE FACE AN OPERATIONAL QUESTION OF SOME CONSIDERABLE IMPORT, I.E. HOW TO TRANSLATE RATHER BROAD GENERIC CATEGORIES OF CRITICAL TECHNOLOGIES INCLUDED IN THE MCTL INTO SPECIFIC DETAILED ITEMS FOR CONTROL PURPOSES.

THUS, WE ARE MOVEING AHEAD WITH A PLAN TO IMPLEMENT THE CONTROLS ON CRITICAL TECHNICAL DATA BY APRIL 1985.

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Mr. WALGREN. Thank you very much.

Let me ask whether, in this area of critical technical data, do you see that reaching into symposium presentations in the United States, in the universities and the like?

Mr. ARCHEY. Well, it does even presently without regard to MCTL. If a proscribed country's national were to come to a scientific meeting in the United States, where the subject of that scientific presentation was dealing with significant technologies or technologies, the products of those technologies would be controlled. It would be likely we would require a license for that person to attend. We have, in fact, licensed on occasions foreign nationals to attend certain scientific conferences in the United States.

Mr. WALGREN. So present circumstances require a license at that point?

Mr. ARCHEY. If it was, for example, an Eastern bloc country coming to a scientific meeting where sensitive technologies or sensitive, militarily-relevant dual use commodities were being discussed in any kind of a detailed manner, it is likely a license would be required.

Mr. WALGREN. Well, thank you very much for your time. We appreciate your having stayed.

Mr. ARCHEY. Thank you, Mr. Chairman.

Mr. WALGREN. Dr. Kane, I apologize for your being sort of at the end here. It certainly is only the way it worked out and not the way anybody ordered this. We certainly would appreciate any thoughts or summaries you would like to give us at this point.

Dr. KANE. Thank you, Mr. Chairman. I will do as you suggested. I ask that my formal remarks be included in the record, and I will summarize the Department's position very briefly. It is briefly because many of the things I intended to say have been said not only once but in some cases twice, and in most cases better than I would have said them. So I will be very informal in my comments.

Why are we here? Why is the Department of Energy here? We are a very large supporter of research on the basic side of the picture, about $2.5 billion in the last fiscal year of research that I would call long-range, fundamental research. Over $300 million of that goes directly to universities in the form of grants, so we are large trainers of students. So we have a very vested interest in the health of this basic research enterprise in the United States and it is vital to our mission. That is why the Department is here and very interested.

The Department does have responsibilities that require classification, so we are very familiar with classification. We have operated under the Atomic Energy Act since immediately after World War II. As you know, we produce nuclear weapons, and we also produce nuclear materials that are essential for nuclear explosives. This whole program has many elements that are classified and I believe will always be classified.

I do not believe, however, that it is of great interest to this committee meeting today because of two aspects. Everything in this system in the formal classification is yes or no. It is either classified or it isn't. There are no gray areas.

Second, this program does not impinge on the universities, since virtually all the classified work, as you heard earlier, is not done on campuses. So I just mention this as a matter of record.

Third, we do have a category of controlled information that is not classified, and yet we control it. This is due to acts of Congress and almost all of this relates to information which would be conducive to proliferation, information that would be conducive to acts of sabotage of our facilities or the theft of nuclear materials. A lot of those things are not classified in the strictly formal classification sense, yet reasonable people agree that it would be very unwise to distribute widely that kind of information. It, too, I don't believe is the subject of this hearing, since most of it is nontechnical, it is not scientific in nature, and again it does not affect the universities at all. I include it in my testimony because it's an example of what you might call a gray area, something we seek to protect and yet is not classified strictly in the formal sense of the word.

The main reason for me appearing here today is to give you the Department's views on how we handle research and the information it produces, in what previous speakers termed "gray areas"—not classified, but yet with some aspects that would make it of interest for national security.

In a word, the Department's view is that expansion of these gray areas is unwise. Now, I realize "unwise" is a highly judgmental word and it's a judgmental opinion by the senior members of the Department. The reasons for this are really two categories why we think it's unwise to enlarge gray areas. One is that we think it is counterproductive.

Now, I promised you I would be brief. You heard reasons from half-a-dozen of the previous speakers as to why they thought the restriction of information which is not classified would be counterproductive to the health of the research effort of this country. We subscribe to the views that you heard, so I won't repeat them again.

The second, we think, besides being just the wrong thing to do in the sense of the health of the research enterprise, we think it would just be impossibly cumbersome, awkward, and difficult to enforce with any kind of fairness or uniformity. I think you have had adequate examples of that today. What are shades of gray? Where do you put the line? How do you establish it, who does it? All those questions that we think would just tremendously occupy and bedevil both the scientists that work for us and the administrators that support these scientists. So those two adjectives, you know, really unwise and burdensome, I think describe the Department's viewpoint toward enlarging or going into gray areas that have not this yes or no aspect.

I think, since I promised you to be brief, I will just read the last paragraph of the formal testimony which says it again.

The Department's current system of formal classification of technical information has worked well. We don't think it has been a burden and we expect it to continue with very little involvement with basic research, very little involvement with universities. In section 148 of the Atomic Energy Act and the Nuclear Nonproliferation Act of 1978 Congress has given us authority to set up very

carefully defined areas of information which are not classified in the formal sense, yet which we restrict.

Now, let me give you one example of that. We think it would be terribly unwise to give engineering drawings of the buildings in which we fabricate plutonium—a map for terrorists, in other words. We think that's not classified perhaps but terribly unwise. We believe that's a correct position and we think Congress thinks that is a correct position.

Now, attempts to create additional, particularly broad classes of sensitive information outside this formal system, particularly in the engineering or basic physical and biological sciences are inadvisable.

[The prepared statement of Dr. Kane follows:]

Statement of James S. Kane
Deputy Director of Energy Research
Department of Energy
Before the Subcommittees on Investigation and Oversight
and Science Research and Technology
House Committee on Science and Technology
May 24, 1984

Mr. Chairman and Members of the Subcommittee, I am pleased to appear before you to present the Department of Energy's position on scientific communication and national security. The Congress provided the Department of Energy with over two and one half billion dollars in Research and Development budget authority for Fiscal Year 1984. Through this funding the Department is a major participant in the nation's research and development enterprise, and we have a vested interest in maintaining the health of that enterprise.

I understand that the purpose of this hearing is to solicit the Department's views on the issue of limiting access to certain categories of technical information. The primary purpose of such limitations is to prevent the use of that information from benefiting the military capabilities of other nations.

Before I give you the Department's position on this issue, I want to differentiate clearly between such limitation of access and the long standing practice of classifying information which relates to national defense and certain aspects of nuclear energy. We recognize and appreciate the need for and value of formal classification and control of sensitive information of military value. The Department feels that the present classification policy and procedures have served the Nation well for a long time.

In addition, the Congress has recognized the need to control information in clearly defined technical areas through enactment of the Nuclear Non-Proliferation Act of 1978 and the addition of Section 148 to the Atomic Energy Act in 1981. The Department fully appreciates the need to limit the spread of nuclear weapons and minimize the likelihood of theft, diversion or sabotage of nuclear material or nuclear related defense facilities that is addressed by these statutes. Most of the work affected by the Department's control of sensitive information in response to these laws is carried out within Department of Energy owned laboratories and has negligible impact on the research conducted at universities.

Thus there are specific areas in our defense programs where it has been necessary for the Department to control the dissemination of sensitive information which is not classified. (Security of research facilities from terrorist activity and sabotage are also covered by the above enacted statutes.) While this action is vitally important, the areas remain extremely narrow when compared with the broad spectrum of research activities carried on by the Department. Specific restrictions like these do not appear to impose onerous burdens on the main research activities of the Department although they may have some effect on the academic and industrial communities with which defense programs interact.

Having called your attention to our concerns I will now give the Department's views on access to other, non-classified research information. The important question is the extent to which we place information in these "gray areas" because it is not sufficiently vital to national security to

justify formal classification or control, yet it could provide some benefit to the military capabilities of other nations. It is the Department's position that enlarging the number and scope of these "gray areas" beyond the few clearly defined topics previously mentioned is unwise. Such action would harm the vitality of American science and technology and such restriction would be enormously complicated and burdensome to enforce.

The United States is blessed with a strong and healthy technology base. Free and open exchange between researchers has made a major contribution to our scientific and technical eminence. We should think very carefully before we change such a successful system.

Enactment of the Stevenson-Wydler Act (Public Law 96-480) has provided the Department with a congressional mandate to make sure that the general public benefits from the fruits of federally-funded research. Of course, this mandate has to be reconciled with other statutes which restrict information flow in certain areas. Considerable effort has been expended within the Department to ensure that the technology developed within the national laboratories, and elsewhere with federal funds, is transferred to the public sector. The creation of new broad areas of controlled access information would be a major obstacle to this mandated effort.

It should be recognized, further, that the United States is not the world leader in all areas of technology. In many areas, such as materials research, the United States benefits greatly from communications with

foreign researchers. If the freedom of our researchers to communicate with their foreign counterparts were limited, their foreign counterparts would doubtless reciprocate. This would isolate our scientists from valuable research performed outside the U.S., and greatly inhibit domestic efforts.

Furthermore, scientific communication controls aimed solely at foreign nationals do interfere with communications between Americans, because scientific journals and meetings, which would be subject to these controls, are important vehicles of scientific communication domestically, as well as internationally.

In addition to these fundamental concerns the administration of broadened restrictions would be extremely complex and burdensome. A standard for equitable imposition of the restrictions would be difficult to construct. The Department alone has many thousands of research projects. As a practical matter, so many publications result from contracts with universities and other institutions, that the Department is not prepared to screen them all for sensitive material prior to publication. Much of our research is conducted at universities, where teaching and research are inseparable, and where foreign nationals represent a significant percentage of the U.S. graduate population. Curbs applied to scientific communications at universities create a nightmare of confusion and disruption. Most importantly, attempts to control communication within universities would surely raise issues of academic freedom.

In summary, DOE's current system of formal classification of technical information has worked well without imposing an onerous burden on the research enterprise. Section 148 of the Atomic Energy Act and the Nuclear Nonproliferation Act of 1978 have created carefully defined areas of unclassified, sensitive information that is controlled because of nuclear proliferation concerns, terrorists concerns, or obvious direct military applications. Attempts to create additional broad classes of "sensitive" information outside the formal system, particularly in the engineering or basic physical and biological sciences are inadvisable. DOE believes such attempts would more likely impede the progress that has given us technological superiority in the past, and it would place an enormous administrative burden on both researchers and their government sponsors.

Thank you for giving me the opportunity to testify.

Mr. WALGREN. Inasmuch as they're inadvisable, I understand your testimony to mean that your restrictions in the recent past have been limited to those authorities in the Atomic Energy Act and your classification procedures.

Dr. KANE. I believe that is true, yes.

Mr. WALGREN. And so there would not have been efforts to restrict publication or restrict transfer other than pursuant to those authorities?

Dr. KANE. That's correct. Now, in my opinion, and in all my experience, the Department has had very few activities of which they have interfered with meetings or restricted publication. And all these have been under the authority of the Atomic Energy Act when this has been done.

Mr. WALGREN. During the period of this controversy—which may be coming to a close, I don't know—the question is what sort of informal efforts have Government agencies made to sort of restrain the academic community and other researchers from actions which, from the Government's point of view, may have an adverse effect, other than operating under your statutory authority to limit certain transfers?

Dr. KANE. To my knowledge, there has been none. I have been intimately acquainted with the research part of the Department for the last 6 or 7 years, and during that period I am not aware of a single case where we have used any pressure, either overt, such as restricting publications, or interfering with meetings, or not quite as overt, where we tried to influence people on the subject matter of their research. To my knowledge, there have been none.

Mr. WALGREN. And just briefly, in the national laboratories that are under your supervision, what kind of a review is gone through with respect to presentations by scientists in those laboratories at conferences or other kinds of public presentations?

Dr. KANE. Certainly, again, the strictures of the Atomic Energy Act are—Before anyone can publish a paper that works for one of the national laboratories, it has to have a clearance, and these are—at many of our laboratories, that aren't weapons laboratories, this is hardly a problem. It is certainly something that has to be done for every publication coming out of the weapons laboratories, although many of those papers are unclassified.

But those are all cleared, to see that they conform to classification under the Atomic Energy Act.

Mr. WALGREN. And when there's a denial, is there an appeals process of some kind or a review of the denial, do you know?

Dr. KANE. There are people that could give you a good answer on that. I am not one of them. There is a committee of senior scientists that reviews technical classification issues, but I do not know exactly what appeal mechanism there is on a specific case for unclassified information. I can provide that for you, if you wish.

Mr. WALGREN. We would appreciate that. And could you also see if you can provide us with frequency experience over the last 4 years. Would the numbers of appeals or requests for reconsideration of a denial, would that be something that could easily be surveyed from——

Dr. KANE. I think our Internationsl Security Affairs people could give you this information quite simply.

Mr. WALGREN. And our purpose is simply to see whether this is an accelerating problem or whether it is one that is on the same trend line it has always been on, or whether there is any change there in frequency. So if I could ask you, if you could try to supply us with data on appeals, numbers of appeals of initial denials and also the disposition of those appeals, how many of those appeals was the decision reversed——

Dr. KANE. And you clearly intend these to be from the national laboratories, because, you know, I'm aware of none at universities. If your intent is employees of the national laboratories, that's another situation, yes.

I'm not aware of any there, but I surely couldn't say there are none. I will get you that information.

Mr. WALGREN. Let's focus on the national laboratories alone and that will certainly serve the committee's purpose. And let's say for maybe the last 4 years.

Dr. KANE. Four years.

Mr. WALGREN. If that's possible. I don't mean to——

Dr. KANE. I believe it's possible.

[The information follows:]

When material has been found to be unclassified, restrictions to publish are fixed by the Atomic Energy Act.

A survey of representative Department of Energy (DOE) field offices and national laboratories revealed that each facility has implemented internal procedures for reviewing unclassified articles, publications and speeches. Though there is no uniformity in the approaches taken, each facility is comfortable with its procedure. An "appeal" mechanism is included in the procedures of all facilities surveyed.

Requests to publish or make oral presentations are reviewed at the technical level. The request is further escalated to the Department Director where final technical approval is given. The Department Director is usually a derivative classifier and is able to determine if the information requires a classification review. Some laboratories suggest concurrence by their Classification Group prior to publication. All laboratories ask for a clearance from the Patents Section to insure that patents are not being violated. In the event that a specific DOE program area wants headquarters approval, the requests are usually favorably resolved in an expeditious manner.

Changes to manuscripts can be recommended at each level of the review process. Revisions are made with the concurrence of the author and his or her superiors. There are few, if any, instances where it has been necessary for disagreements to be escalated to the director of a laboratory or field office.

Information about the frequency of appeals is not available as the field offices and laboratories surveyed are unaware of cases where an "appeal" was officially registered. DOE and laboratory personnel are uniformly supportive of the procedures under which they publish.

Mr. WALGREN [continuing]. To be very burdensome, but if the information does exist, I think it would be a helpful addition to the record.

Are there any restrictions on people that leave the Department of Energy? How do you handle scientists that leave the laboratories or something like that?

Dr. KANE. Again, if I tell you something that's not quite right, I'll get back and correct it. Every one that leaves a weapons laboratory, or probably any laboratory where you've had access to classified material, is given a briefing on their departure from the laboratory, just reminding them of the consequences of the classification system.

Mr. WALGREN. So they would simply be under the continuing restraint that everybody would be under, not to reveal classified information?

Dr. KANE. They might be under additional constraints. I will explain by letter if this is true. I think it would be quite reasonable, if somebody has just been working on sensitive nuclear weapons, for instance, to perhaps restrict travel or something like that for a short period of time.

Mr. WALGREN. If you could outline those restrictions——

Dr. KANE. If any, yes.

[The information follows:]

With respect to employees terminating employment with DOE or DOE contractor organizations who have had access to classified information, each terminating individual who has been granted a security clearance by DOE must be interviewed and sign DOE Form 5631.29 (attached). This form contains the only restrictions on former employees who have been granted a DOE security clearance.

DOE F 5631.29
(3-94)
(Previously DP-136)

(Facility or Installation Where Terminated)

U.S. DEPARTMENT OF ENERGY

SECURITY TERMINATION STATEMENT

NAME AND TITLE (Print all blocks)	EMPLOYER YOU ARE LEAVING
FUTURE RESIDENCE	NAME AND ADDRESS OF FUTURE EMPLOYER:
REASON FOR TERMINATION:	
SOCIAL SECURITY NUMBER:	DATE OF BIRTH:
DATE OF TERMINATION:	DOE NUMBER (IF KNOWN)

I make the following statement in connection with the forthcoming termination of my security clearance or access authorization granted by the Department of Energy:

1. I have destroyed in accordance with DOE security regulations or transferred to persons designated by the Department of Energy all classified documents and material which I was charged or which I had in my possession.

2. I shall not reveal to any person any Restricted Data, Formerly Restricted Data, or other classified information of which I have gained knowledge except as authorized by law, regulations of the Department of Energy, or in writing by officials of the Department of Energy empowered to grant permission for such disclosure.

3. I am aware that the Atomic Energy Act of 1954 and U.S. Code, Title 18 "Crimes and Criminal Procedures," prescribe penalties for unauthorized disclosure of Restricted Data, Formerly Restricted Data, and other information relating to the national defense.

4. I am aware that I may be subject to criminal penalties if I have made any statement of material facts knowing that such statement is false or if I wilfully conceal any material fact (Title 18, U.S. Code, Section 1001).

5. I know that the Department of Energy desires to be informed when former DOE or DOE contractor personnel enter the military service if they have had access to Top Secret information or classified information currently of material sensitivity to the national security.

6. I understand that the Department of Energy desires to be informed when persons who have been granted DOE access authorization propose to travel to communist countries. This does not apply to individuals who obtain DOE access authorization and receive access to Restricted Data or Formerly Restricted Data solely as employees of other Government agencies or their contractors.

(Normally, an individual will not be asked to forego any travel unless the travel is of such a nature as to be considered unwise from the standpoint of personal safety or there are special circumstances existing which would make such travel unwise from the standpoint of the national security. The DOE's security interest in such travel normally diminishes as the period of access to Restricted Data, Formerly Restricted Data or other classified information becomes more remote.)

(Signature of Person Conducting Interview)

(Signature of Person Whose Access Authorization is Being Terminated

(Title of Position)

(Date)

• U.S. Government Printing Office: 1998-341-075/1010

See reverse for Privacy Act Statement

PRIVACY ACT STATEMENT

Collection of the information requested is authorized by the Atomic Energy Act of 1954, as amended, and by Executive Orders 10865, 10450, and 12356.

The name of the individual, Social Security Number, and date of birth are used as identifying factors to establish and maintain records of DOE personnel clearance actions in the DOE System of Records DOE-42, "The Personnel Security Clearance Index." This form will become part of the individual's Personnel Security File (Department of Energy System of Records DOE-43, "Personnel Security Files").

Disclosure of the information on this form is voluntary. Access to the completed form is limited to authorized investigators from Federal agencies.

Mr. WALGREN [continuing]. For us, that would be helpful.

Dr. KANE. I shouldn't be so glib because I'm not sure there are any.

Mr. WALGREN. OK. Well, on behalf of the committee we appreciate your contribution. It's a very real one. Thank you for coming.

[Whereupon, at 1:50 p.m., the joint subcommittees were adjourned.]

APPENDIX

American Association
for the Advancement of Science

1515 MASSACHUSETTS AVENUE, NW., WASHINGTON, D. C., 20005

Phone: 467-4400 (Area Code 202) Cable Address: Advancesci, Washington, D. C.

July 6, 1984

Dear Colleagues:

The American Association for the Advancement of Science (AAAS) is charged by its Constitution to "further the work of scientists and to facilitate cooperation among them." AAAS is further charged to "foster scientific freedom and responsibility."

In this context, government policies which prevent or inhibit the release of unclassified research information in the classroom, research laboratory, scientific journals or meetings directly encroach upon both the educational mission and well-settled principles of openness in scientific communication.

These concerns led to the adoption by the AAAS Council at the 1984 AAAS Annual Meeting on May 28, of the enclosed Resolution on Openness and National Security. The Council urges government officials to be mindful of the Association's concerns in developing policies which may directly or indirectly result in restrictions on the communication or publication of unclassified research.

Sincerely,

William D. Carey
Executive Officer

Enclosure

RECEIVED
JUL 1984
COMMITTEE ON SCIENCE
AND TECHNOLOGY

American Association
for the Advancement of Science

1515 MASSACHUSETTS AVENUE, NW, WASHINGTON, D. C., 20005

Phone: 467 4400 (Area Code 202) Cable Address: Advancesci, Washington, D. C.

Openness and National Security, submitted by the AAAS Committee on Scientific Freedom and Responsibility.

Whereas progress in science and technology is greatly enhanced by open communication; and

Whereas such progress promotes both the national security, however defined, and the general welfare; and

Whereas public availability of unclassified scientific and technical information is a necessity for democratic decision-making in a wide range of important public policy issues,

Be it resolved that the American Association for the Advancement of Science strongly reaffirms its opposition to continuing governmental efforts to restrict the communication or publication of unclassified research.

Adopted by the
AAAS Council
May 28, 1984

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